THE ENGINEER

OCTOBER 2, 1959 | 28 ESSEX STREET, STRAND, LONDON, W.C.2 | TWO SHILLINGS

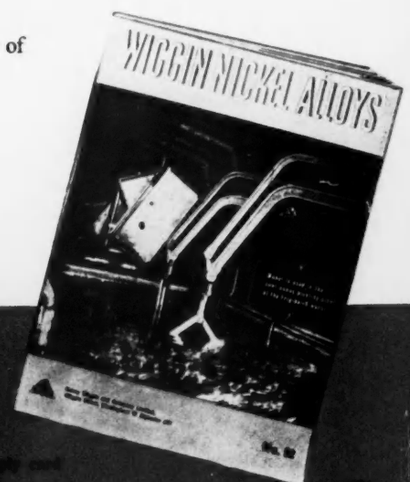
Welcome break

FOR NEW IDEAS

Welcome break for tea — and enlightenment ! In almost every industry, you'll find people *finding time* to read 'WIGGIN NICKEL ALLOYS'. That is because they find in it many examples of the use of Wiggin high-nickel alloys to solve problems of corrosion and heat which they also may meet.

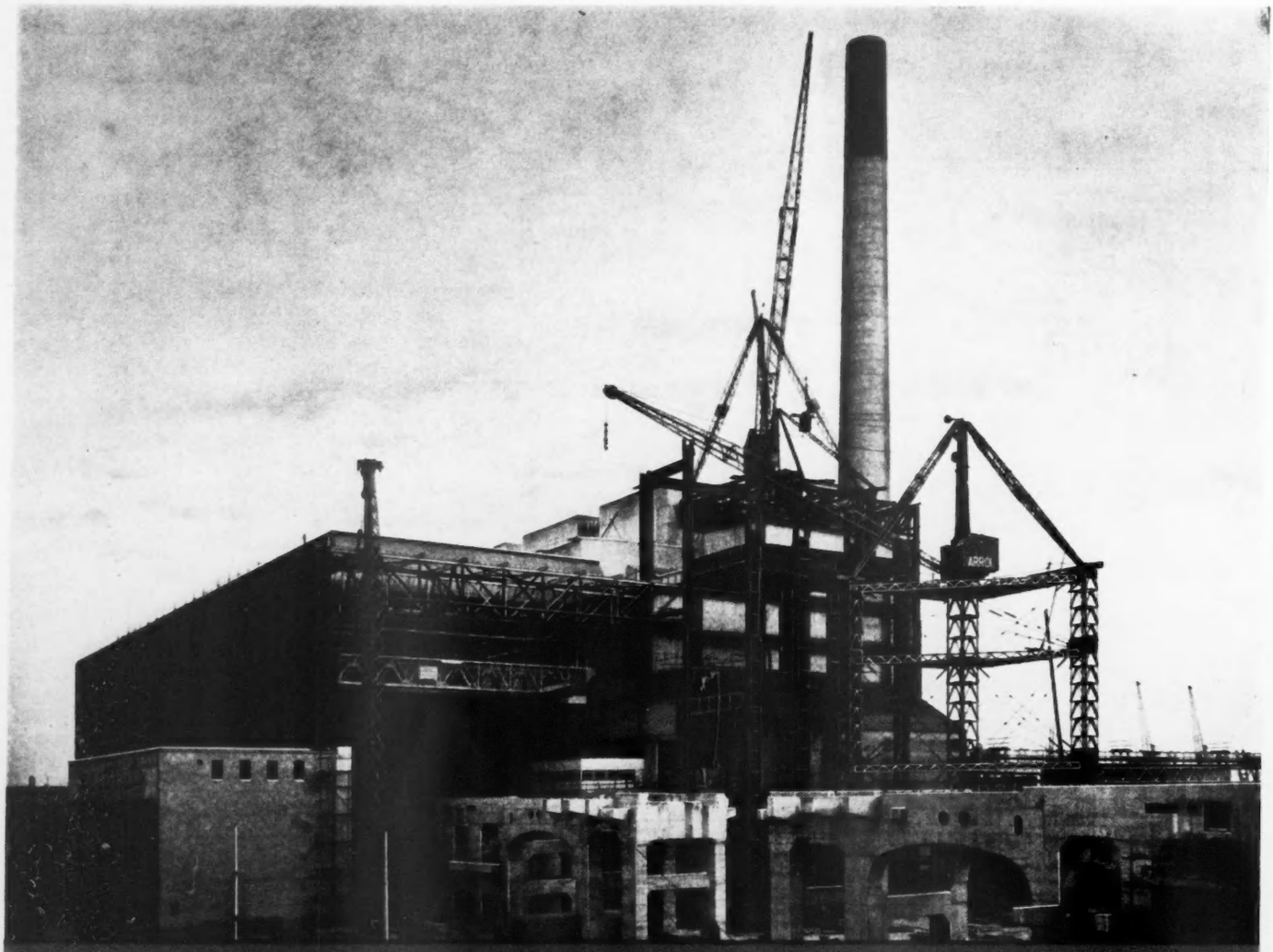
SOME CONTENTS OF THE CURRENT ISSUE

Cutting Vitreous Enamelling Costs with *Nimonic and *Inconel High-Temperature Alloys
Nimonic Alloys versus High-Temperature Corrosion
*Monel in Feed-Water Heaters
Nimonic 105
America's Space Ship Skinned with Inconel X
Hot TCP Stored in Nickel Tanks
Engineering Design of Oak Ridge Fluoride Plant
Experimental Aircraft Reactor Uses Inconel
*Incoloy
Nickel Alloys v. Corrosion
Monel in Continuous Pickling Plant



Send for a specimen copy of WIGGIN NICKEL ALLOYS

HENRY WIGGIN & CO LIMITED · WIGGIN STREET · BIRMINGHAM 16



Steelwork for Power Stations

Throughout the country steel-framed Power Station structures indicate the close association of ARROL of GLASGOW with Britain's electrical power development. Battersea and others in the London area, Castle Donington in Leicestershire and Braehead at Glasgow comprise a long series now being further extended by the erection of the steel framework of Belvedere Power Station—another of the London Group.

All types of steel Framed Buildings; Fixed and Opening Bridges; Cranes and Mechanical Engineering work; Dock Gates; Sliding and Floating Caissons; Compressed Air Locks; Hydraulic Machinery; Pipe Lines, Surge Tanks, Sluices and other equipment for Hydro-Electric Projects.

SIR WILLIAM ARROL & CO LTD GLASGOW

Arrol

Enter No. C2 on reply card

THE ENGINEER

Established 1856

No. 5410 **OCTOBER 2, 1959** VOL. 208

EDITORIAL CONTENTS

Leading Articles

The Delta Scheme . . . 329
Fuel for Power . . . 329
Demarcation Disputes . . . 330
Water Shortage in Some Areas . . . 330
Write for Details . . . 331

Articles

100 Years Ago . . . 331
London Spaceflight Meetings . . . 332
"Hoister" Equipment for Tanker Offshore Loading . . . 335
The Dutch Delta Plan . . . 337
Construction of Haringvliet Dam . . . 341
Veersche Gat Dam . . . 346
The Surge Barrier . . . 351
Traction Equipment for 50 c/s Trains . . . 353
Submarine Telephone Cable Between U.S.A. and Europe . . . 355
Electricity Supply in England and Wales . . . 357
Redesigned Light Car . . . 359
Oxy-Fuel-Gas Cutting Equipment . . . 360
Heating of New Diesel Trains . . . 361
British Waterworks Association . . . 362
Centenary of Far-Eastern Voyage of a Ben Line Ship . . . 362
Opening of the Whitegate Refinery . . . 362
Microwave Telephone Network in Malaya . . . 362
Communications Equipment Display . . . 362
Argon Chromatograph . . . 363
Mobile Drilling Rig . . . 363
Industrial Tractor and Equipment . . . 364
Space Heaters . . . 364

Continental Section

European Machine Tool Exhibition. No. III . . . 366
International Motor Show at Frankfurt. No. III . . . 368
Train Accelerations Follow Electrification . . . 370
Economics of Materials Handling . . . 370

American Section

Corrosion Research at the National Bureau of Standards . . . 371
Direct Production of Strip Steel from Iron Ore . . . 373

BOOK REVIEWS . . . 356

NEWS AND NOTES

Industrial and Labour Notes . . . 365
Personal and Business . . . 374
British Patent Specifications . . . 375
Forthcoming Engagements . . . 376

INDEX TO ADVERTISERS : PAGE 155 **CLASSIFIED ADVERTISEMENTS : PAGE 147**

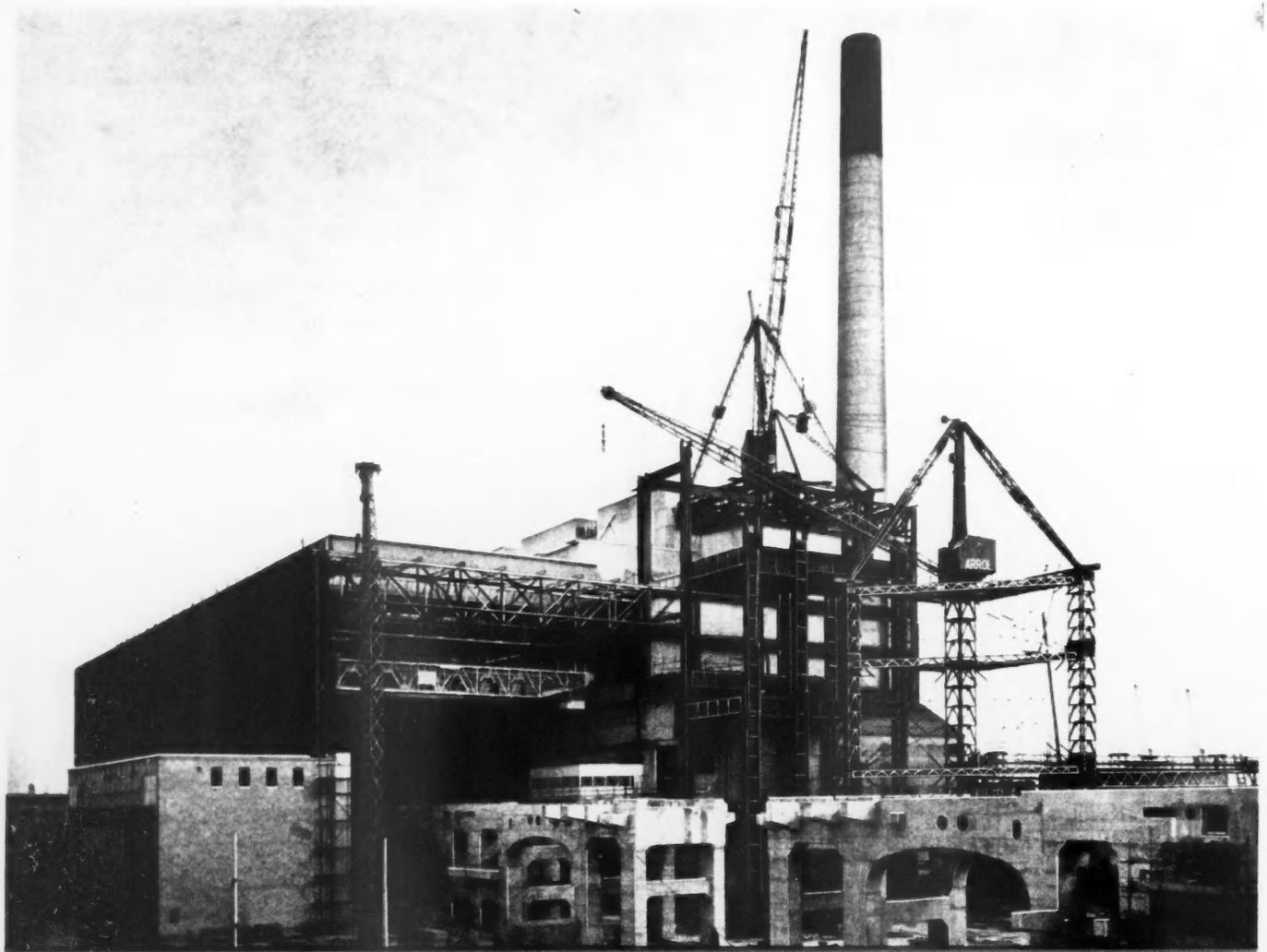
NOTICE TO READERS No undertaking can be given to return illustrations or manuscripts. Correspondents are requested to keep copies. No notice is taken of anonymous communications.

SUBSCRIPTIONS U.K. and ABROAD £5 10. 0. p.a., including postage (CANADA £5 5. 0.). Single copies 2s. each, plus 9d. postage. Also on sale at newsagents.

'THE ENGINEER' BUYERS GUIDE Published annually. One FREE copy is sent to all direct postal subscribers on publication and delivered by newsagents to all regular readers. Additional copies are obtainable at 7s. 6d. each. Postage 1s. 9d. extra.

Published every Friday by

MORGAN BROTHERS (PUBLISHERS) LTD., AT 28, ESSEX STREET, STRAND, LONDON, W.C.2. Telephone : CENtral 6565



Steelwork for Power Stations

Throughout the country steel-framed Power Station structures indicate the close association of ARROL of GLASGOW with Britain's electrical power development. Battersea and others in the London area, Castle Donington in Leicestershire and Braehead at Glasgow comprise a long series now being further extended by the erection of the steel framework of Belvedere Power Station—another of the London Group.

All types of steel Framed Buildings; Fixed and Opening Bridges; Cranes and Mechanical Engineering work; Doch Gates; Sliding and Floating Caissons; Compressed Air Locks; Hydraulic Machinery; Pipe Lines, Surge Tanks, Sluices and other equipment for Hydro-Electric Projects.

SIR WILLIAM ARROL & CO LTD GLASGOW

Arrol

Enter No. C2 on reply card

THE ENGINEER

Established 1856

No. 5410 **OCTOBER 2, 1959** VOL. 208

EDITORIAL CONTENTS

Leading Articles

The Delta Scheme . . . 329
Fuel for Power . . . 329
Demarcation Disputes . . . 330
Water Shortage in Some Areas . . . 330
Write for Details . . . 331

Articles

100 Years Ago . . . 331
London Spaceflight Meetings . . . 332
"Hoister" Equipment for Tanker Offshore Loading . . . 335
The Dutch Delta Plan . . . 337
Construction of Haringvliet Dam . . . 341
Veersche Gat Dam . . . 346
The Surge Barrier . . . 351
Traction Equipment for 50 c/s Trains . . . 353
Submarine Telephone Cable Between U.S.A. and Europe . . . 355
Electricity Supply in England and Wales . . . 357
Redesigned Light Car . . . 359
Oxy-Fuel-Gas Cutting Equipment . . . 360
Heating of New Diesel Trains . . . 361
British Waterworks Association . . . 362
Centenary of Far-Eastern Voyage of a Ben Line Ship . . . 362
Opening of the Whitegate Refinery . . . 362
Microwave Telephone Network in Malaya . . . 362
Communications Equipment Display . . . 362
Argon Chromatograph . . . 363
Mobile Drilling Rig . . . 363
Industrial Tractor and Equipment . . . 364
Space Heaters . . . 364

Continental Section

European Machine Tool Exhibition. No. III . . . 366
International Motor Show at Frankfurt. No. III . . . 368
Train Accelerations Follow Electrification . . . 370
Economics of Materials Handling . . . 370

American Section

Corrosion Research at the National Bureau of Standards . . . 371
Direct Production of Strip Steel from Iron Ore . . . 373

BOOK REVIEWS . . . 356

NEWS AND NOTES

Industrial and Labour Notes . . . 365
Personal and Business . . . 374
British Patent Specifications . . . 375
Forthcoming Engagements . . . 376

INDEX TO ADVERTISERS : PAGE 155 **CLASSIFIED ADVERTISEMENTS : PAGE 147**

NOTICE TO READERS No undertaking can be given to return illustrations or manuscripts. Correspondents are requested to keep copies. No notice is taken of anonymous communications.

SUBSCRIPTIONS U.K. and ABROAD £5 10 0 p.a., including postage (CANADA £5 5 0.). Single copies 2s. each, plus 9d. postage. Also on sale at newsagents.

"THE ENGINEER" BUYERS GUIDE Published annually. One FREE copy is sent to all direct postal subscribers on publication and delivered by newsagents to all regular readers. Additional copies are obtainable at 7s. 6d. each. Postage 1s. 9d. extra.

Published every Friday by

MORGAN BROTHERS (PUBLISHERS) LTD., AT 28, ESSEX STREET, STRAND, LONDON, W.C.2. Telephone : CENtral 6565

Deal with out-of-balance once and for all

AVERY have their own fool-proof method of dealing with the harmful effects of out-of-balance in rotating parts. Oscillation measurements (a) quickly determine the variation from uniform mass distribution about the fixed axis of rotation (b) bring these variations together into measuring planes, and (c) show them in components, or as a vector value.

But each rotor has its own individual characteristics. Every one must be considered as a separate entity in terms of weight, diameter, compensation planes, etc. When in motion (remember, you can't detect out-of-balance in a static work-piece) other all-important factors are involved; the best form of drive, correct speed, appropriate bearings . . . .

Only a dynamic balancing programme which meets all these requirements can be considered adequate to deal with any one specific work-piece. AVERY have perfected just such a programme . . . . a whole range of machines to suit any type of component. Whatever your particular problem in this field, AVERY has the answer. Send for illustrated booklet No. DB595 or write to the address below.

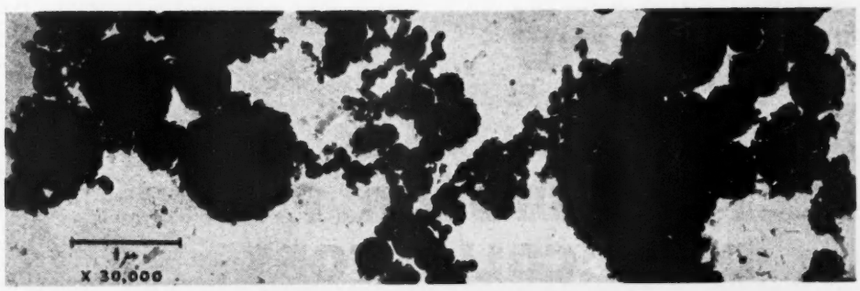
AVERY for **ELECTRODYNAMIC BALANCING**

W. & T. Avery, Limited, Soho Foundry, Birmingham 40.

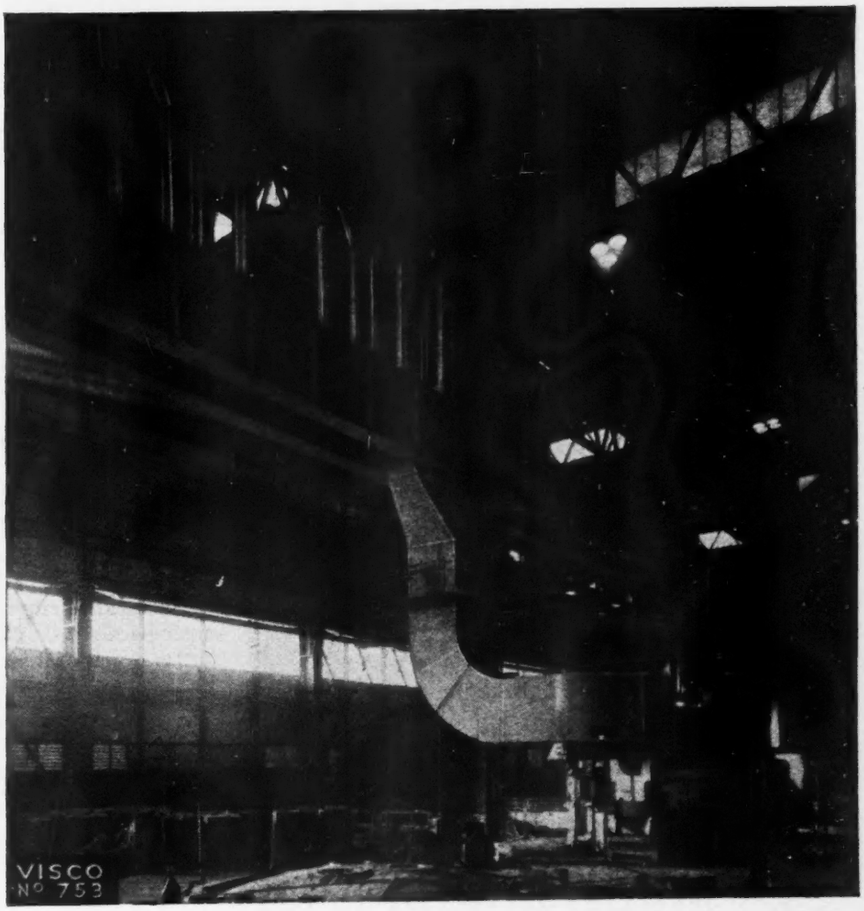
Enter No. 21 on reply card

VISCO AND ARC FURNACE FUME & DUST REMOVAL

A healthy atmosphere prevails from Furnaces to Board Room wherever 'VISCO' Fume Removal and dust recovery equipment is installed. Some very big companies indeed look upon VISCO as 'the people' in this field—the names and installations prove the point. Don't fume and fog—cut costs by consulting THE VISCO ENGINEERING CO. LTD., STAFFORD ROAD, CROYDON. Telephone CROYDON 4181.



Micro photograph of dust particles collected by the 'Visco-Beth' Patent Automatic Dust Collectors installed at the works of Samuel Fox & Co. Ltd. The lower picture shows the arc furnace with fume and dust collecting ducting.



VISCO
ARC FURNACE
FUME & DUST REMOVAL

FW5

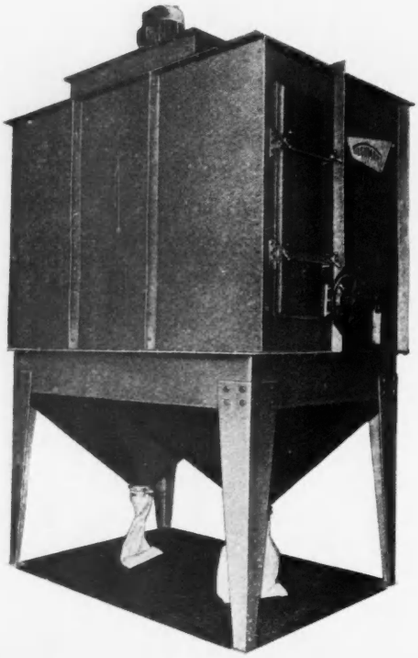
Enter No. 31 on reply card

UNIT DUST COLLECTORS

A range of screen type fabric filters with self contained fan, motor and starter.

These collectors are built with 50 sq. ft. area and 150 sq. ft. area. The volumes handled are from 250 c.f.m. to 2,100 c.f.m. For further details of these collectors, send for our new leaflet, T.53.

3 NEW DUST COLLECTORS

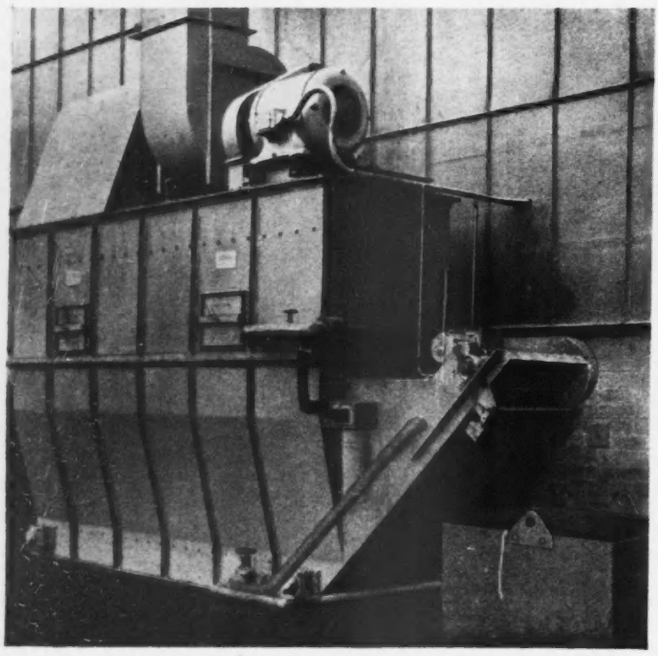


T54 TUBULAR FABRIC DUST COLLECTORS

A range of tubular fabric dust collectors with integral direct driven fan. Where the headroom is limited, dust hoppers or base units can be fitted.

These machines are built in a range of filtering areas from 80 sq. ft. to 720 sq. ft., and standard volumes from 1,000 c.f.m. to 6,000 c.f.m.

These are robustly constructed, high efficiency, dust collectors at low cost. Further details can be obtained by sending for leaflet T.53.



AQUASPRAY WET TYPE DUST COLLECTORS

A Scroll Type wet dust collector with a two stage, self induced spray for higher collecting efficiency These machines are supplied complete with a power driven mechanical sludge ejector.

The standard range is from 1,500 c.f.m. to 24,000 c.f.m., but larger sizes are available on request. Our leaflet T.49 gives further details of these machines.

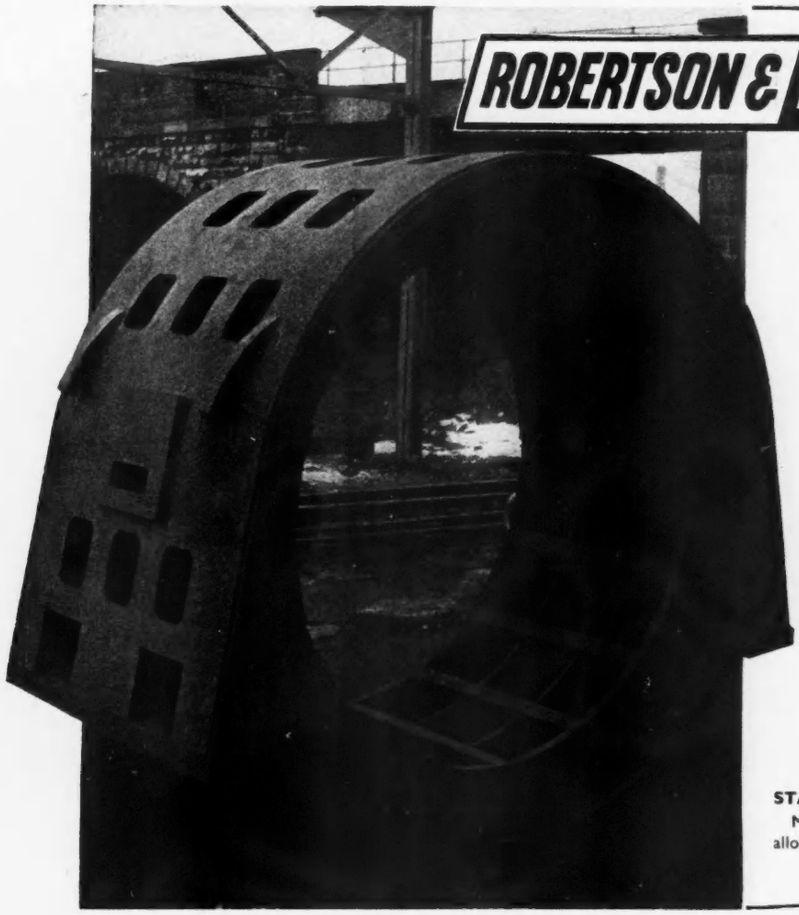
Send for leaflets to,

TILGHMAN'S Ltd.,
Broadheath,
Altrincham,
Cheshire.

A Member of the Staveley Coal & Iron Co., Ltd. Group.
LONDON OFFICE: 1 Chester Street, S.W.1.

W.280

Enter No. 41 on reply card



ROBERTSON & FERGUSON LTD.

for

GENERAL FABRICATION IN MILD STEELS STAINLESS STEELS AND ALUMINIUM ALLOYS

29 MURIESTON CRESCENT, EDINBURGH 11

Telephone : 68501-2-3

STATOR

Medium size stator for synchronous induction motor. Machining allowances on bore feet and end faces, all to ½" all dimensions ± 1/16"

Enter No. 51 on reply card

. . . . **Sutton 7-Roll Straighteners**

TRULY GUIDELESS

BRITISH PATENT 665,557

FOR HIGH PRODUCTION,
HIGH QUALITY STRAIGHTENING OF STEEL
OR NON-FERROUS TUBES AND PIPES

AVAILABLE IN ALL SIZES FOR 5/16" TO 24" TUBES

Exclusive Features

- *MINIMUM TO MAXIMUM SIZE CHANGEOVER IN LESS THAN FIVE MINUTES.*
- *CONTINUOUS STRAIGHTENING OF TUBES AND PIPES, WITH OR WITHOUT UPSET ENDS.*
- *OPERATES WITHOUT GUIDES.*
- *CAN BE IN LINE WITH TUBE MILL.*
- *SPEEDS UP TO 800 FT. PER MINUTE.*

NOW MANUFACTURED UNDER EXCLUSIVE LICENCE BY

FARMER NORTON

SIR JAMES FARMER NORTON & CO. LTD.

ADELPHI IRONWORKS, SALFORD 3, MANCHESTER

Telephone : Blackfriars 3613-4-5, 3692-3. Telegrams : "Agricola" Manchester.

Enter No. 52 on reply card

Heatrae of Norwich

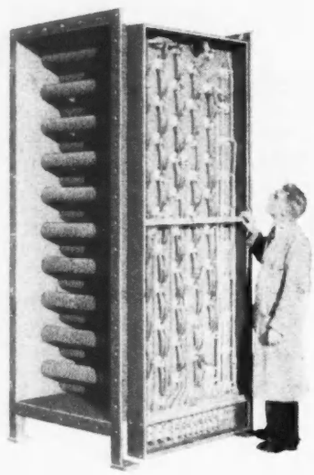
Heatrae Limited, from the earliest days of electric air heaters, have offered to industry a complete design and manufacturing service for the production of Electric Air Heaters for specific requirements.

It may well be that you have an air-heating problem which we can help solve at the lowest possible cost.

Illustrated left, an example of equipment designed for vertical duct work. Illustration right, shows a rectangular unit for inserting into a horizontal duct.

★

★ *These two types are intended for low air pressures, but Heatrae also make Drum type Heaters suitable for high pressure working. Full details on request.*



HEATRAE LTD · NORWICH · ENGLAND

Telegrams: HEATRAE · NORWICH Telephone: NORWICH 25131 (Private Exchange)

Manufacturers of : Electric Water Heaters, Oil Heaters, Immersion Heaters, Urns, Towel Rails, Airing Cupboard Heaters, Flameproof Heating Apparatus, Breakfast Cookers, Electric Fires, Food Trolleys, Warming Plates, Air Heaters, etc.

Enter No. 61 on reply card

Bearing Bracket in Malleable Iron. Weight 3¼ lbs.

Brake shoe for small vehicle in Malleable Iron

"As clean as a Gloucester Casting" means that Gloucester malleable iron castings are of high definition, true to pattern, cleaner and smoother because of better sand practice and better fettling.

Mould and core sands and their bonding additives are under constant laboratory supervision, even the very sand grains are sized and numbered, and consistency and distribution of sand are strictly controlled by a continuous mechanical unit. The high refractory characteristics prevent sand "burn-on" at re-entrant angles, thus greatly increasing the life of cutting tools during the machining process. The new elevator-type electric furnace anneals in 48 hours — instead of the usual 7 days. It also allows greater control of the component during annealing, resulting in uniformity of metal, greater strength, and resistance to impact

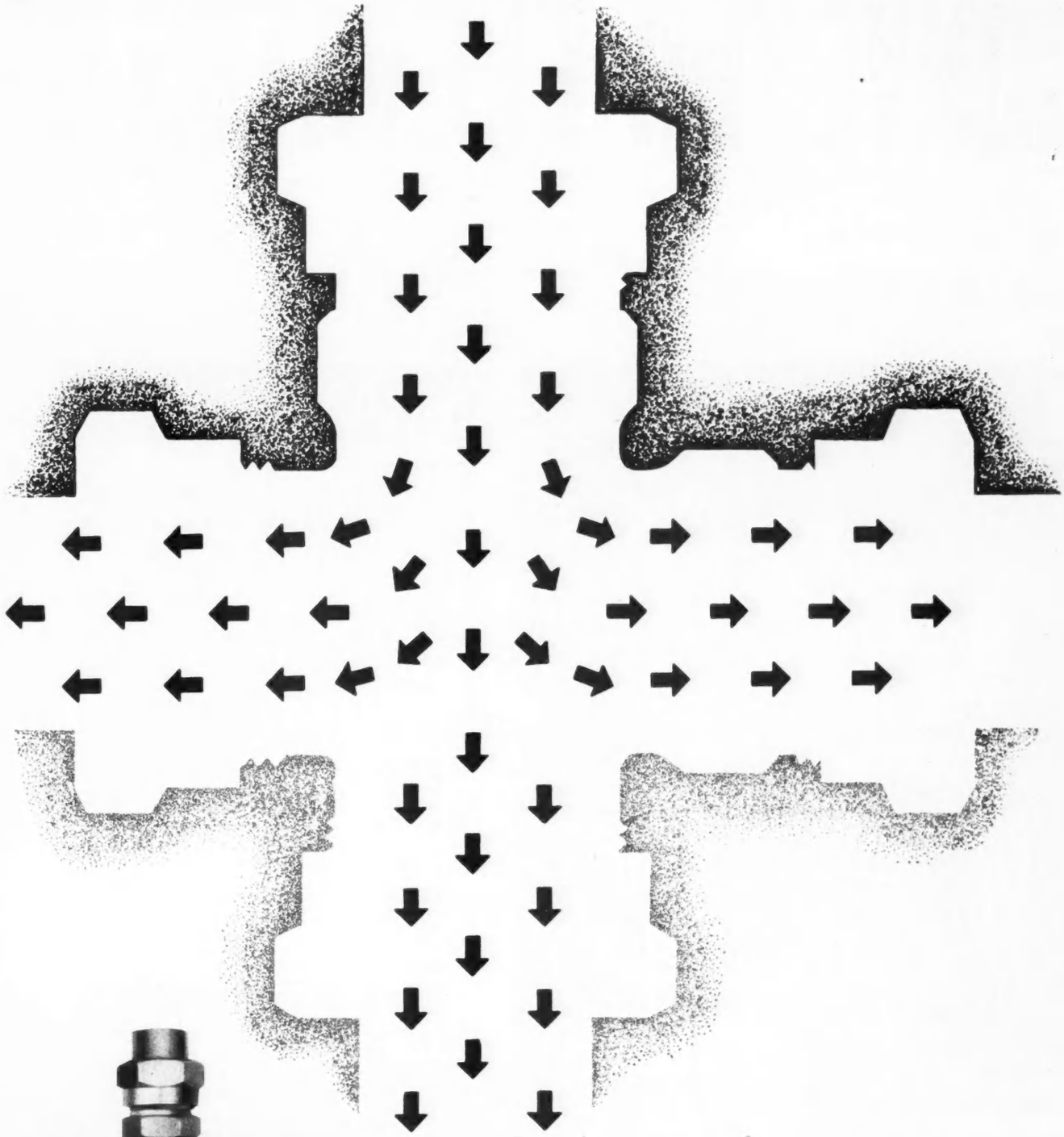
A typical Gloucester Malleable specification.

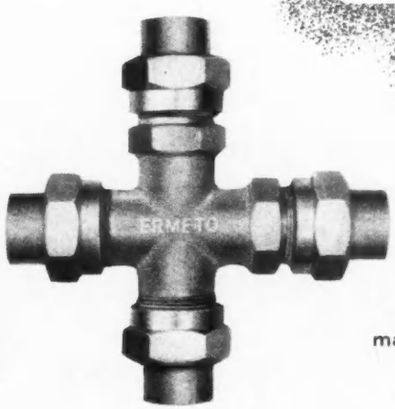
Gloucester Blackheart Malleable	*Gloucester Lamellar Pearlitic Malleable*
Elongation .. 18%	Elongation .. 5%
Yield Point .. 12 tons	Yield Point .. 24 tons
Tensile Strength 25 tons psi	Tensile Strength 35 tons psi

GLOUCESTER

Gloucester Foundry Ltd. Emlyn Works, Gloucester · Telephone: Gloucester 23041 · Telegrams: 'Pulleys' Gloucester · A subsidiary of the Gloucester Railway Carriage & Wagon Co. Ltd.

Enter No. 62 on reply card





in connection with high pressure

ERMETO HIGH PRESSURE COUPLINGS are specified by many leading manufacturers, because they are the most reliable fittings on the market for every high pressure installation. Our catalogue illustrating the full range of standard fittings will be sent to you on request. Non-standard fittings can also be made to suit your specification. Our technical experience is at your service.

BRITISH ERMETO CORPORATION LTD ERMETO

HARGRAVE ROAD MAIDENHEAD BERKS TELEPHONE: MAIDENHEAD 5100 A MEMBER OF THE ALENCO GROUP OF COMPANIES

Enter No. 71 on reply card

CONVEYOR AND ELEVATOR Co (1936) LTD.

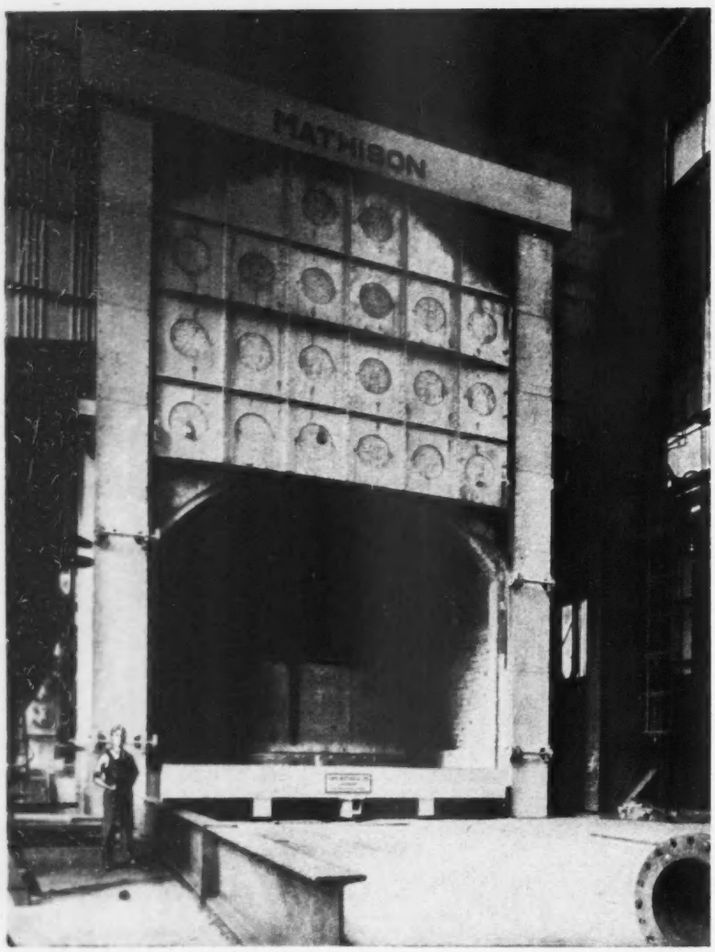
LOWER BRIDGE WORKS

SPIRAL CONVEYORS,
BUCKET ELEVATORS, Etc.

ACCRINGTON

Telephone : No. 2779
Telegrams: " Conveyor, " Accrington

Enter No. 81 on reply card



MATHISON

STRESS RELIEVING FURNACES "MATHISON" VERTICAL FLAME RECIRCULATING TYPE

Town gas fired.

Load : 60 tons.

Fuel Consumption : Under 4,500 cu. ft. per ton.

Temperature Range : 200°-900° C.

Electrically Operated Bogie Haulage Gear : To move maximum load of 150 tons.

Temperature Uniformity on 4-zone Control : plus or minus 5° C.

Internal Dimensions of Furnace illustrated : 27' 2" long × 25' 6" wide × 21' 0" to the centre of the arch.

Scale totally eliminated.

"Our latest installation, in the most modern Heavy Plate Fabricating Shop at Messrs. Head Wrightson Teesdale Limited, Thornaby-on-Tees. Designed and built, and put into commission by . . . . . .

JOHN MATHISON LTD,
Engineers,
HUTTON HALL · GUISBOROUGH
North Yorks, England

Enter No. 82 on reply card

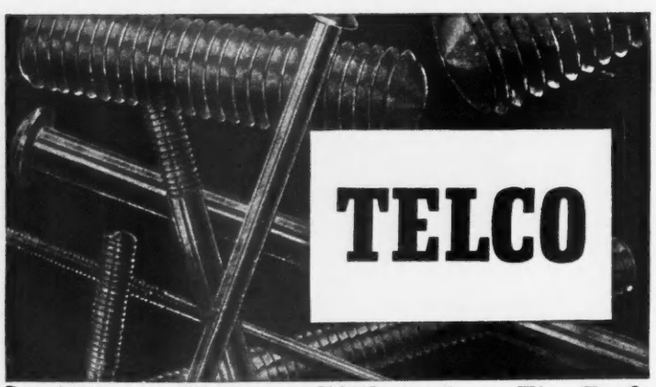
The Nitriding Process for Case-hardening Special Steels by Nitrogen offers

- Surface hardness up to 1100 D.P.H.
- Retention of full hardness after heating to 500°C.
- Maximum resistance to frictional wear and fatigue.
- Improved resistance to corrosion by water and steam.

Particulars from:—

NITRALLOY LIMITED
ATLAS WORKS SHEFFIELD, 4.
Telephone: Sheffield 26646. Telegrams: "NITRALLOY, SHEFFIELD."

Enter No. 83 on reply card



Studding · Studs · Allthreads · Tie Rods

TELCO LTD., 3 Newman Street, London, W.1 MUSeum 5701/4

Enter No. 84 on reply card

Now is your opportunity to take advantage of

Do you require

Manufacturing facilities for a complete product?
Manufacture or processing of your product components?

Babcock & Wilcox Ltd., who recently acquired the finely-equipped works of the former Royal Ordnance Factory at Dalmuir, which they are now applying to the manufacture of Babcock atomic power plant, cranes, materials-handling equipment, welded pressure-vessels etc., also offer to industry generally a *first-class service for the manufacture or processing of complete mechanical products or components.* This includes all kinds of machining, grinding, gear-manufacture, welding, heat-treatment, electroplating etc., backed by tool-room facilities of the highest standard, and inspection to A.I.D. and Lloyds requirements.

These facilities, combined with the Company's Renfrew Works capacity for the production of forgings, pressings and castings, provide a comprehensive, experienced and economic manufacturing service which may well be the answer to *your* production requirements.

Write or phone now for booklet:
"BABCOCK — Dalmuir Manufacturing Service",
to: SALES DEPARTMENT,
DALMUIR WORKS,
BABCOCK & WILCOX, LTD.,
BEARDMORE STREET,
DALMUIR, GLASGOW.
Telephone: CLYDEBANK 1841

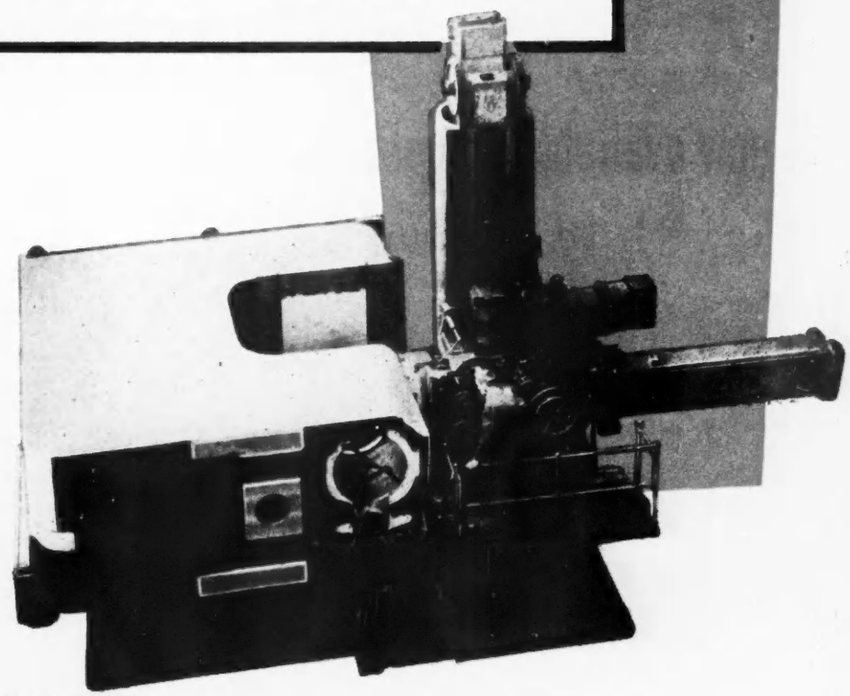
A NEW COMPREHENSIVE MANUFACTURING SERVICE

for heavy mechanical plant and components

BABCOCK ···*Dalmuir*

TURNING
BORING
MILLING (including precision work)
GEAR-MANUFACTURE
PLANING
GRINDING
BROACHING, SLOTTING etc.
WELDING
SHOT-BLASTING
STRESS-RELIEVING
HEAT-TREATMENT
Carburizing, Hardening, Tempering
ELECTROPLATING
Copper, Nickel, Cadmium, Chromium
WAXING, CLEANING
RUST-PREVENTION etc.
IRON CASTINGS
from precision shell-moulded to heavy dry-sand castings, up to 20 tons
STEEL CASTINGS
in carbon and alloy steels from 1 lb. up to 5 tons
FORGINGS AND PRESSINGS
STRUCTURAL STEELWORK

Ample cranage and road, rail or sea delivery facilities available for the heaviest items.



BABCOCK & WILCOX LTD Head Office: BABCOCK HOUSE, 209 EUSTON ROAD, LONDON, N.W.1
DALMUIR WORKS: BEARDMORE STREET, DALMUIR, GLASGOW

Enter No. 91 on reply card

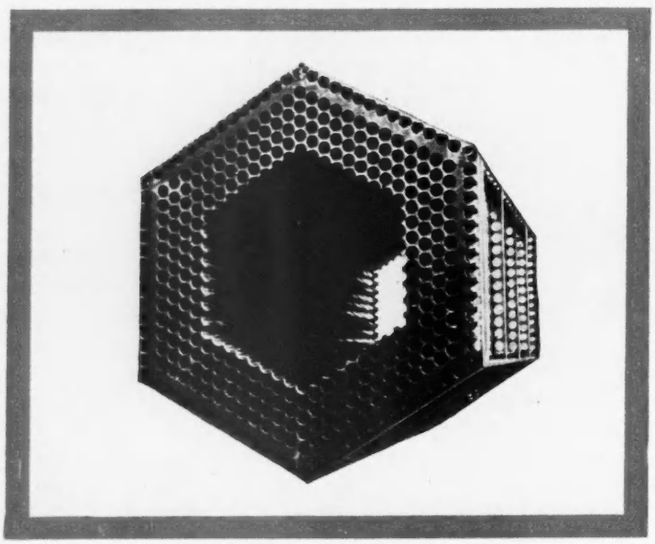
B

all the skill that went into THIS...

(Fairey Rotodyne, the first vertical take-off airliner in the world.)

Ten years ago Fairey was entirely engrossed with aircraft production. Today a review of the Group's activities presents a very different picture.
Our Engineering Division's production of aluminium fabrications of 100 tons a month has been supplemented by heavy iron and steel castings, welded steel and stainless steel pressure vessels, fabrications in all metals up to 80 ft. in length.

and THIS...



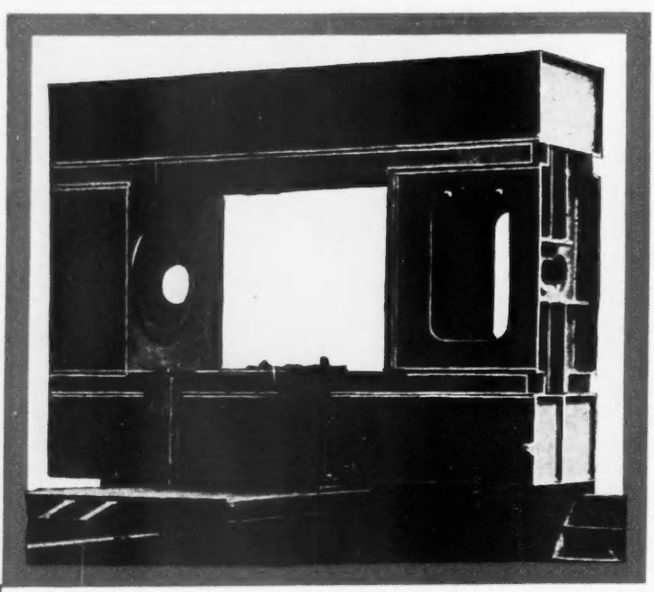
(Gagging Skirt for the Dounreay fast nuclear reactor manufactured completely in stainless steel 18/8/1 and weighing 30 cwt.)

Capacity includes:

FABRICATION OF STRUCTURES, TANKS, PRESSURE VESSELS IN MILD & STAINLESS STEELS, ALUMINIUM, SPECIAL ALLOYS: PRECISION CASTINGS AND PRESSINGS
Test procedures, which include X-ray, vacuum and ultrasonic, can also take advantage of specialised techniques developed by other members of the Fairey Group.

Standards met include AID, ARB, UKAEA, Lloyd's Class 1.

is now available for jobs like THIS...



(Steel fabricated frame for a 200-ton Himulti double-action press.)

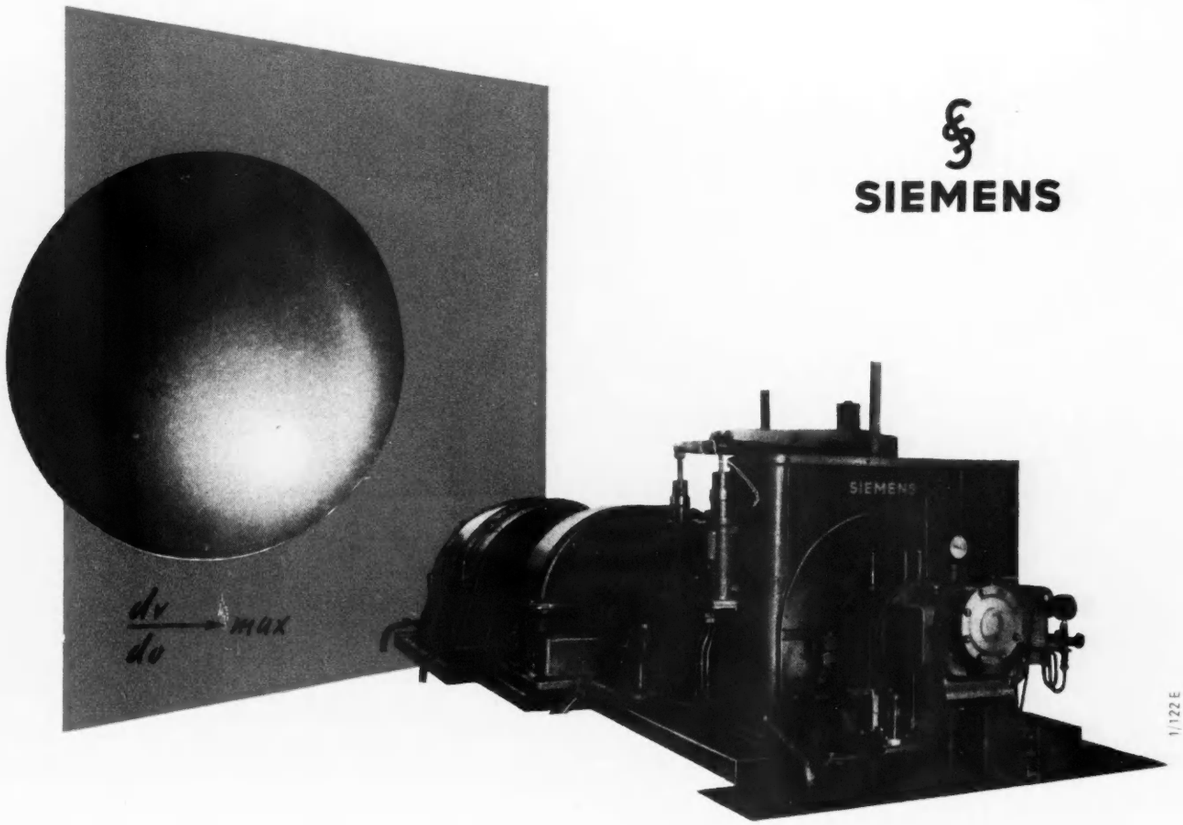
Fairey

engineering for industry

Fairey Engineering Limited, Stockport, Cheshire.
A member of The Fairey Group of Companies.

aviation · air survey · marine · electronics · instrumentation and control · hydraulics · atomics · fabrication · plastics

Enter No. 101 on reply card



SIEMENS

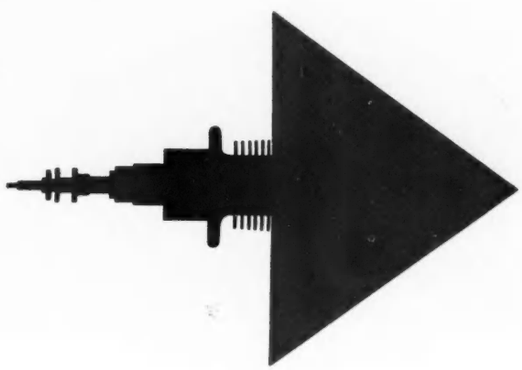
To obtain a maximum number of kilowatt hours from the operating steam

that is the ambition of our turbine experts. It will, of course, never be possible to attain a hundred per cent "efficiency" as is the case with a sphere which with a given surface area encloses a maximum volume. It has, however, been possible to raise the efficiency of our turbines to a degree nearer to the optimum value.

Thus for instance the efficiency has been improved appreciably, particularly at partial loads, by the round-head profile of the reaction blades. The clearance losses have been reduced to a minimum by integral shroudings.

Together with the sealing strips on the stationary guide-blade holders these provide a three-fold labyrinth seal.

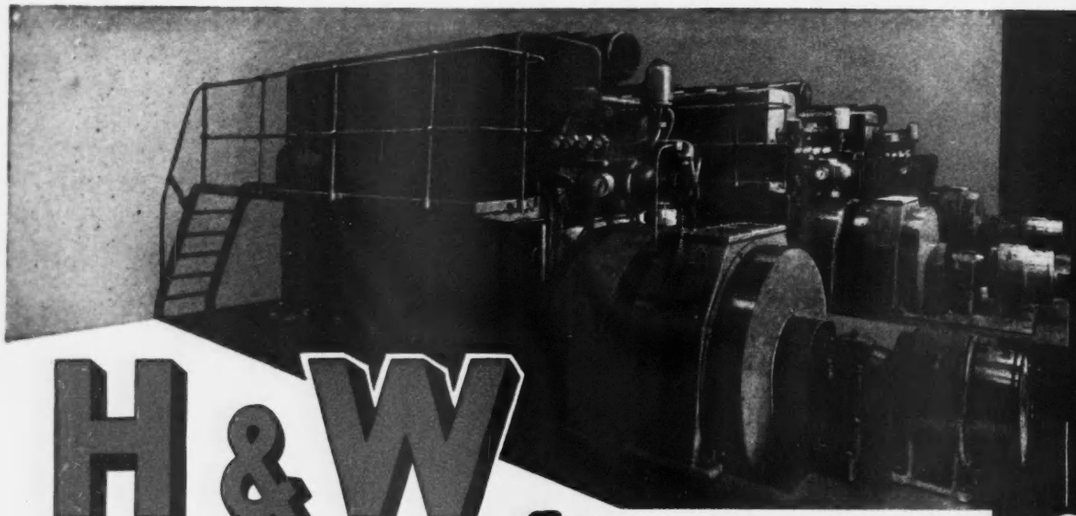
In our new turbine works at Wesel we are utilizing the wealth of experience which we gained during the decades of work at our main works at Mülheim.



Quick delivery from our new works at Wesel

SIEMENS-SCHUCKERTWERKE AKTIENGESELLSCHAFT
BERLIN · ERLANGEN

Enter No. 111 on reply card



Three H & W dual-fuel engines with H & W alternators. Each alternator set develops 330 kW at 428 r.p.m. and operates on sludge gas

H&W Alternator Sets

Alternators and engines are of H & W design and manufacture thus ensuring our undivided responsibility for the complete power set. We also supply the necessary control equipment.

H & W alternators supplied in all sizes from 60 to 5,000 kVA and voltages up to 11 kV. with H & W 2- or 4-stroke turbo-charged Diesel engines

("In line" and "V" type 4-st. Diesel engines can be supplied naturally aspirated or turbo-charged with or without air coolers)

HARLAND & WOLFF LIMITED

Enquiries: Queen's Island, Belfast — London Office: 9, Whitehall, S.W.1

BELFAST GLASGOW LONDON LIVERPOOL SOUTHAMPTON

Enter No. 121 on reply card

Heavy – Medium – Light

NON-FERROUS SAND CASTINGS

IN ALUMINIUM BRONZES • MANGANESE BRONZES • NICKEL BRONZES • PHOSPHOR BRONZES • GUN METALS • ALUMINIUM ETC. • PATTERNMAKING AND MACHINING

HERE IS A GROUP OF TYPICAL BRONZE CASTINGS THE LARGEST WEIGHING 35 CWTS

CHILL CAST PHOSPHOR BRONZE AND GUN METAL · SOLID AND CORED BARS FOR BUSHES, LINERS, ETC.

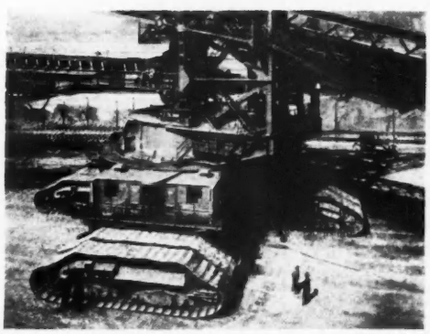
J.T. PRICE & CO.

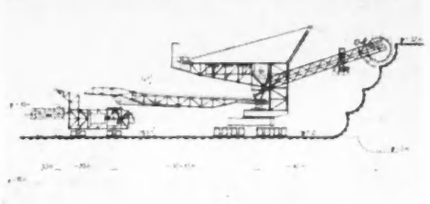
(BRASS & ALUMINIUM FOUNDERS LTD)

Foundrymen of Repute

NEWCASTLE • STAFFS • *Phone : 52311 (3 lines)*

Enter No. 122 on reply card





We advise you

in all projects involving the winning of materials and their transportation. We design for you complete open cast and underground mining schemes and the necessary mechanical equipment on the basis of the manifold experience of our mining, excavation and conveyor engineers.

We construct

supply and erect for you excavators, either rail or caterpillar mounted, for mining, canal construction, dam building, etc., such as bucket ladder excavators, bucket wheel excavators, spreaders, special equipment, complete bunkering plant, conveyor bridges, stationary and shiftable conveyors, loading and handling plant.

FRIED. KRUPP MASCHINEN- UND STAHLBAU RHEINHAUSEN

U. K. Agents: J. M. J. Maus Ltd., 35 New Broad Street, London E. C. 2

Enter No. 131 on reply card

C

Silicones for engineering

MS MIDLAND SILICONES LTD

MS

Silicone rubber insulated cables defy heat

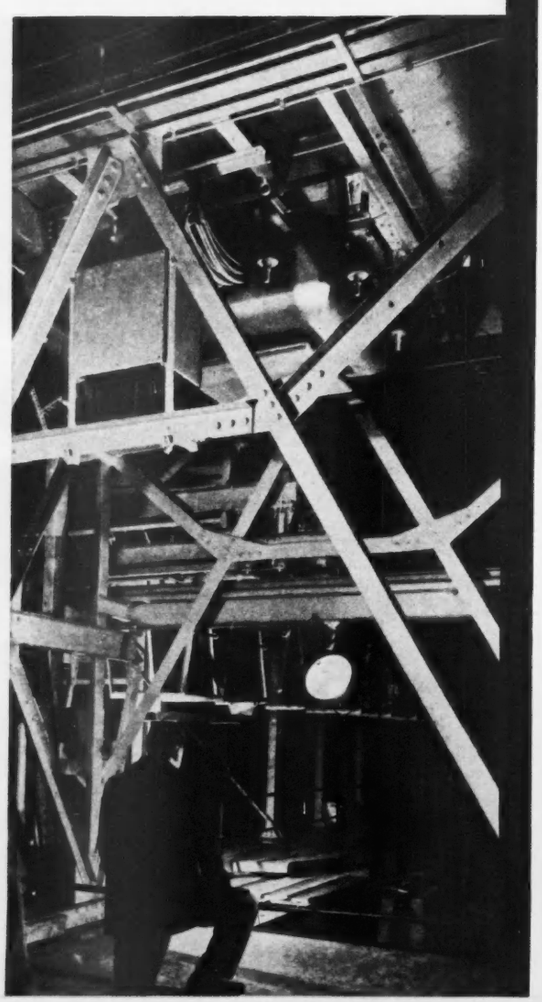
Silicone rubber insulated cables are used to supply the furnace heater batteries at the Rogerstone plant of Northern Aluminium Co Ltd and operate at an average temperature of 135°C. Each cable is 2200/.0076" single conductor tinned copper wire, silicone rubber insulated, asbestos roved, glass braided and silicone varnished—C.M.A. 660V grade.

The advantages of silicone rubber insulated cables are that they:

- *Give continuous long term operation in ambient temperatures up to 200°C
- *Will operate through and after fire
- *Are resistant to steam, water and many chemicals
- *Do not require any special terminating seals
- *Have excellent resistance to electrical fatigue and corona discharge
- *Are flexible at temperatures as low as -90°C

The silicone rubber insulated cables are installed above the quench tank (shown at the right) in which aluminium slabs are lowered after they have been taken from the furnace.

(Photograph by courtesy of Northern Aluminium Co Ltd)

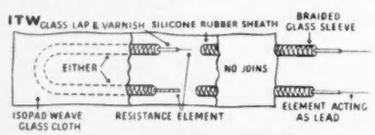


MS

Silastomer* Silicone rubber works where other materials fail!

Isopad Ltd specify Silastomer silicone rubber for covering their flexible heating tapes designed for operation at temperatures of up to 200°C in moist conditions. And for good reason. Silastomer retains its flexibility and excellent dielectric properties over an extremely wide temperature range—from −100°C to +250°C.

No organic rubber can match this performance and that is why Silastomer is specified by Isopad and many other manufacturers for all types of equipment and appliances where reliability is essential—from seals in domestic irons to resilient diaphragms in valves.

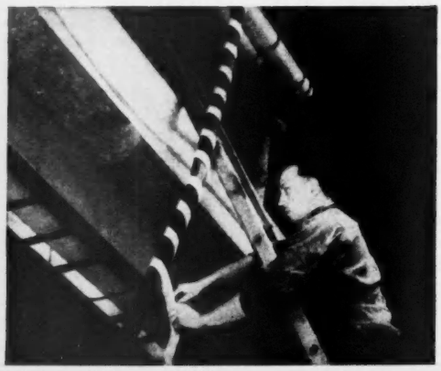


Isotape tape ITW showing the heating elements covered with Silastomer silicone rubber. This weatherproofs the Isotape and makes it suitable for a temperature range of -100°C to 222°C.

*Silastomer is a registered trade mark of Midland Silicones Ltd.

Isotapes being fitted to bitumen feed pipes

(Photograph by courtesy of Isopad Ltd)



MS

Silicone greases remain serviceable from—70°C to +230°C

London Transport were experiencing considerable difficulty during cold weather due to the sticking of unloader valves on the compressors of their Green Line buses. An MS silicone grease solved the problem. Because of their outstanding resistance to extremes of temperature, MS silicone greases remain serviceable over a far wider temperature range than organic lubricants, thus providing reliability in operation and a reduction in maintenance costs. An MS silicone grease or lubricant may offer the most practical and economical solution to your most difficult lubricating problem.

The photograph shows the unloader valve fitted to Green Line buses. Courtesy of London Transport Executive.

Write for full information about these and the many other silicone products with applications in the engineering industry including release agents, damping and hydraulic fluids, heat-resistant paint resins, lubricants and electrical insulants.

MIDLAND SILICONES LTD
68 KNIGHTSBRIDGE • LONDON SW1
Tel: Knightsbridge 7801
Area Sales Offices: Birmingham · Glasgow · Leeds · London
Manchester · *Agents in many countries*

First in British Silicones

MS

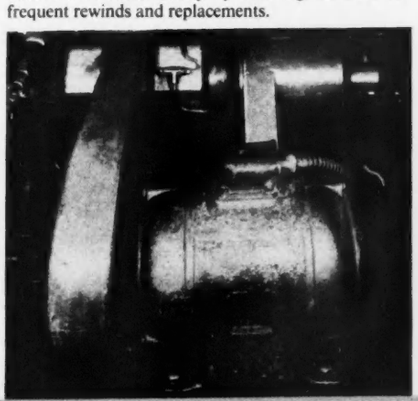
Silicone-insulated motors withstand years of continual 'plugging'

The photograph shows a silicone-insulated motor operating at the Stonehouse Works of Hoffman, Gloucester Ltd, who have kindly provided us with the following information—"We have a bank of 12 machines, each being driven by a 2 h.p. 1425 r.p.m. motor and as the motors have burnt out they have been rewound with silicone insulation, by British Electrical Repairs Ltd, and this has proved very satisfactory over the past 2/3 years.

"These motors are working in unusual conditions, as the following description of their working cycle shows, and they stand up to the work very well indeed.

"A complete operation takes 12 seconds then the machine is operated to reload which takes 2 seconds. To decelerate rapidly to the stop position for loading the operator presses the stop button followed by 'plugging' (pressing the reverse button). This is drastic treatment when continued all day and speaks well for the rewound motors".

This is a typical example of how MS silicone insulation increases the life and reliability of hard-working motors . . . saves money by reducing the need for frequent rewinds and replacements.



MS

Silicone fluids speed production at Mullards

An MS silicone fluid is used in the SPEEDIVAC* vacuum diffusion pumps which serve each plant of this rotary machine for producing Radiant Screen television tubes at the Mullard Television Tube plant at Simonstone. Because of the excellent heat stability and oxidation resistance of the silicone fluids, cooling of the pumps before releasing the vacuum is not necessary. Rapid cycling is therefore possible resulting in more efficient production.

*Trade name of Edwards High Vacuum Ltd

Because of their versatility MS silicone fluids overcome many of the limitations of organic fluids and open the way to improvements in the design of equipment and in production techniques. Advantages include:

* Serviceable temperature range from –100° to 450°F
* Available in viscosities from 0.65 to 1,000,000 centistokes
* High flash points
* Low vapour pressure
* Excellent oxidation resistance
* Low coefficient of expansion
* High degree of compressibility

Write for Silicone Notes G11 which details many of the applications of MS fluids.

(Photograph by courtesy of Mullard Limited)

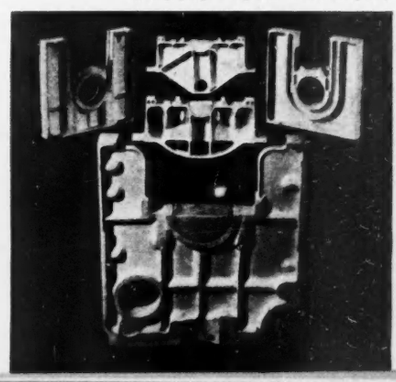
MS

Cold-Cure Silastomer* aids diesel design research

Cold-Cure Silastomer–the silicone rubber that needs no heat to cure–is used for making scale models of diesel engine components to enable their behaviour to be studied under different simulated loads.
Wooden moulds are made, assembled and painted with a release agent and the Cold-Cure Silastomer is poured in and left to set. No special equipment is needed and the models are ready for use in about 24 hours after casting at room temperature.
Cold-Cure Silastomer is remarkably versatile and opens up new fields for designers. The addition of a catalyst is all that is required to cure at room temperature and the material possesses the excellent dielectric properties, heat endurance and high thermal conductivity associated with silicone rubbers.
Cold-Cure Silastomer can be used by unskilled operators to fill voids round lead wires of coils and motors, for impregnating coils, and for other similar sealing or potting applications. It can also be used for making flexible moulds in which epoxide resins are cast.
Write for a sample—on your company letterhead please–of either Cold-Cure Silastomer 9160 or 9161. The former has a spreadable consistency and the latter is suitable for dipping. Silicone Notes K28 is also available listing the properties and applications.

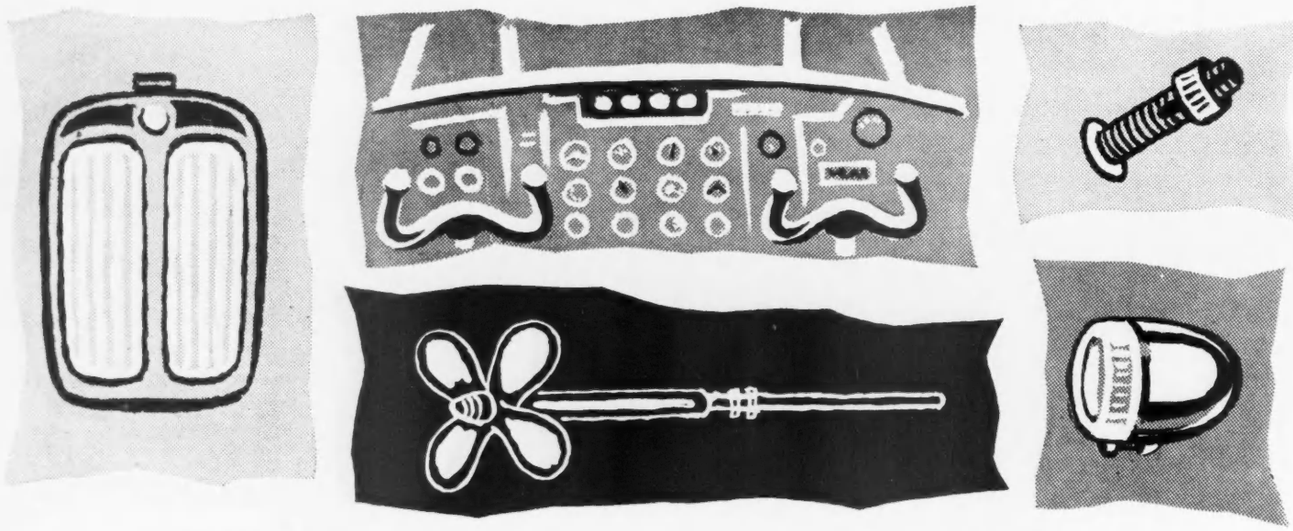
*Silastomer is a registered trade mark of Midland Silicones Ltd.

(Photograph by courtesy of Ruston & Hornsby Ltd)



Miles or knots—you'll find

a need for copper and brass



Land, sea and air; every form of transport needs its quota of copper and brass semis. And every manufacturer needs a reliable supply of these versatile and dependable metals in every form—sheet, strip, rod or wire.

That is a good reason for our existence. Moreover, we have been associated with the transport industry ever since the 'Cutty Sark' first put to sea. That means we have a wealth of practical experience to back the output of our modern and efficient plant. And that's why, when it's a question of copper and brass, the answer is —

ICI METALS DIVISION

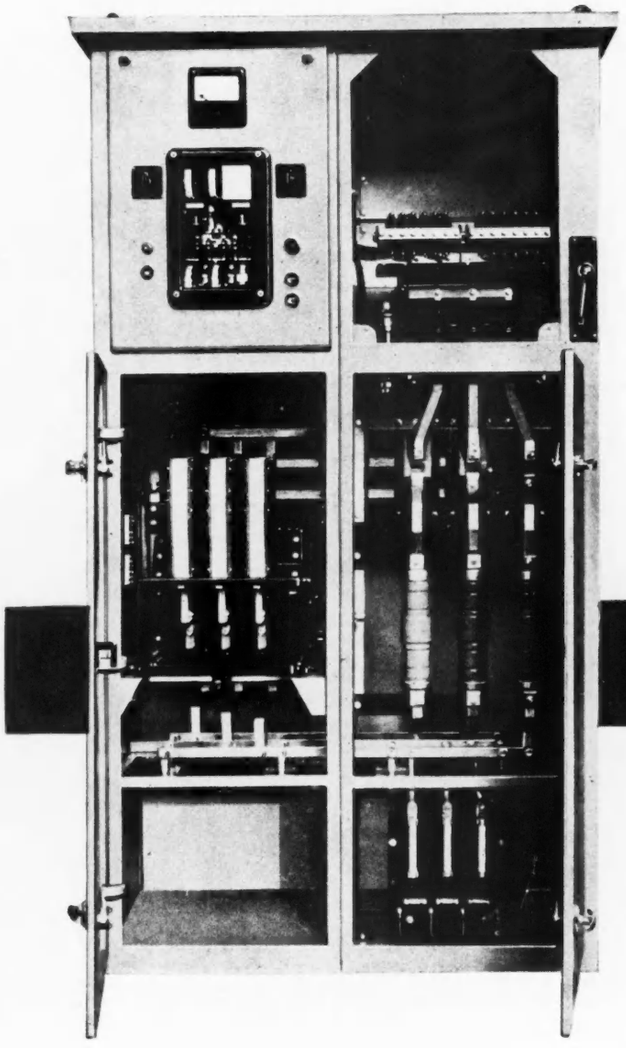
I.C.I. METALS DIVISION

IMPERIAL CHEMICAL INDUSTRIES LIMITED · LONDON · S.W.1

c.8

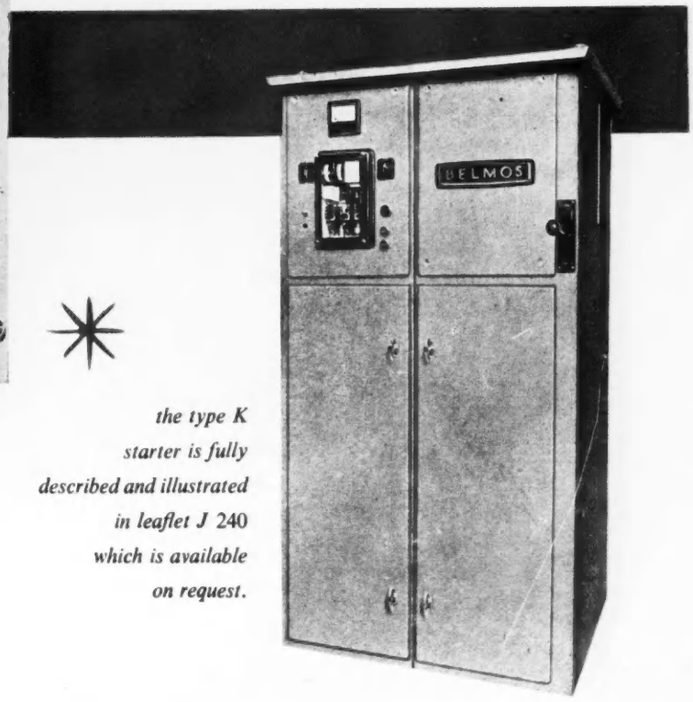
Enter No. 161 on reply card

THE BELMOS 3·3kV AIR-BREAK CONTACTOR STARTER



Rigorously tested in the Company's own research laboratory, the type K contactor starter is the latest product of the Belmos development team and continues the well-established Belmos tradition of good design and reliability. Suitable for the direct-on-line starting of 3·3 kV motors up to 600 h.p., it can be housed in a free-standing pillar or grouped with similar units to form a switchboard.

- ★ Air-break contactor rated at 150 amperes. Breaking capacity of 1,300 amperes at 3·3 kV, 0·25 power factor.
- ★ DC operating magnet supplied from 3,300/110 volt transformer within the pillar.
- ★ Reversing or Earthing isolator, mechanically and electrically interlocked, with 12 auxiliary switches, AC or DC.
- ★ Busbars designed to withstand 150 MVA for 3 seconds.
- ★ Optional earth leakage protection.
- ★ Comprehensive control arrangements, local and remote, with sequence interlocking and automatic sequence starting.
- ★ Provision for auxiliary services, such as brake protection, local lighting, etc.



the type K starter is fully described and illustrated in leaflet J 240 which is available on request.

Belmos

the Belmos company limited

BELLSHILL · LANARKSHIRE

LONDON GLASGOW BIRMINGHAM NEWCASTLE MANCHESTER SHEFFIELD CARDIFF

Enter No. 171 on reply card

D

VOTE FOR JONES-CRANE

ELECTORAL ADDRESS

by

K. L. JONES-CRANE, Esq.

(Agent: George Cohen Sons & Company Limited)

An uplifting appeal to British Industry!

Inappropriate as it would be for me to canvass for your support at the forthcoming General Election — since I already have a comfortable seat and am well able to support myself and about 20-Tons as well—I nevertheless respectfully solicit your Votes.

I do so on the strength of my unchallenged record for unflagging hard work and service to British industry. Indeed, my record cannot be excelled in public life (or public works) and it matches my reputation for all-round efficiency, reliability, unimpeded vision and (direct) drive. I am well known for the exercise of my full power on all motions. Blessed with sensitive overload indicators, I nevertheless repudiate strongly the suggestion that my mother was frightened by an alarm clock. Indeed, it only makes me luff, since I am always up, or down, first thing in the morning and ready to begin work at the mere touch of a button.

Having been born in London some 25 years ago and bred in Letchworth, Herts, where my home still is, I am British to the core of my K L Quality Controlled Steel Castings. I have a reputation as a family man, and am told that my service is unique. You will certainly be familiar with our family motto: "JONES CRANES TAKE THE LOAD" (or as they still say in Oxford: "TROCHLEÆ JONENSES ONUS FERUNT") proudly emblazoned on our escutcheon. It boasts no less than 600 quarterings.

During the late war I saw service all over the Globe with the Royal Navy, the Army and, on many aerodromes, with the Royal Air Force.

In one sense, I suppose, I am not always on the straight and narrow, as I am at my happiest manœuvring out of a tight corner and coping with adverse conditions. In fact, I have an uncanny ability to explore every avenue and leave no stone unturned.

My consumption of fuel and oil is as Conservative as my safety-factors are Liberal; and, despite my light and flexible controls, no-one has done more to lessen the task of Labour or lift the burdens of the British working man.

You will be aware that for years past I have played a leading part in the Highways Programme and on Housing Schemes. Here I have happily collaborated with many back-benchers and, indeed, back-trenchers.

In the field of Agriculture I have done much—as may be apparent from the wording of this address—to foster the production of corn.

My restrictor-wheels both curb over-inflation and guard against the dangers of disinflation.

Like all my family I am loyal to the Monarchy. One of the high spots of my career was when I once cracked an egg with a 6-ton weight in the presence of H.R.H. Princess Margaret.

Finally, let me assure you in British industry that, if I am honoured with your confidence, I shall take the most scrupulous care of your monetary interest and, enheartened by the steadfastness of all my constituents, will never jib at the prompt performance of the many and varied duties which may be required of me.

Please fill in your ballot paper as follows:

K. L. JONES-CRANE	**X**
ALL THE OTHERS	

Enter No. 191 on reply card

ROSS

THE
"RIGBY'S PATENT"
TEAM HAMMER

A phase of Railway Workshop activity abroad—showing "RIGBY'S PATENT" Hammer in operation.

Y SUITABLE
RATING WITH
ESSED AIR

Enter No. 201 on reply card

Bet you we've seen that before

—that component, Sir, which must be made in rubber. Not just *rubber*, but a rubber that will stand up to the conditions *you* want to impose—bet you we've seen that specification before. We've been making rubber of all kinds, in so many shapes and sizes, for so long, for so many industries—that the chances are we already have what you are wanting. If not, we can soon make it.

'Doc' knows all the answers!

In case you didn't see our last advertisement, 'Doc' is the personification of John Bull technical and scientific knowledge. He is always happy to put his brain to work on *your* behalf.

Stretch it
Squeeze it
Heat it
Freeze it

JOHN BULL *Rubber*

JOHN BULL RUBBER CO. LTD. (INDUSTRIAL SALES DIVISION) LEICESTER • TELEPHONE 36531

Enter No. 202 on reply card

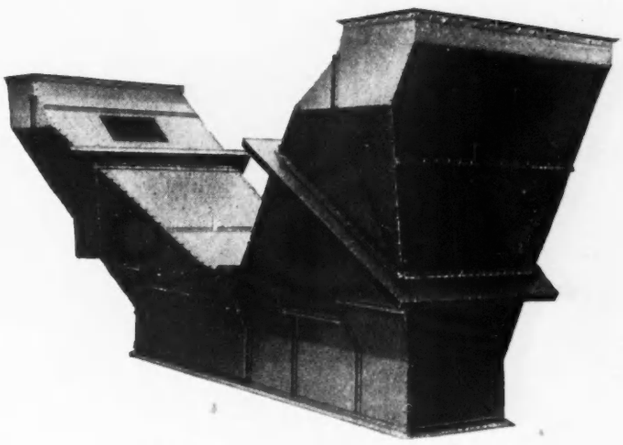
Fabricated Platework by

ALLENS of TIPTON

to your specification

PIPEWORK

We can supply low pressure Gas and Water Mains and high pressure welded unlined Water Piping. We also specialise in bends of large diameter pipes and branch pipes of complicated design.



DUCTS

Ducts of rectangular design for power stations or boiler houses, of electrically-welded construction in Mild or Special Steels or Aluminium Alloy, can also be supplied. They are accurately fabricated to suit your exact requirements.

● *Our latest Brochure "FABRICATED PLATEWORK" fully describes our activities in this field. A copy is yours on request.*

W. G. ALLEN & SONS (TIPTON) LTD.

P · O · BOX 4 · TIPTON · STAFFORDSHIRE.

TELEPHONE : TIPTON 1266

Enter No. 211 on reply card

E

BURGESS

V RANGE

MINIATURE MICRO SWITCHES AND ACTUATORS

PLEASE ASK FOR MORE DETAILS

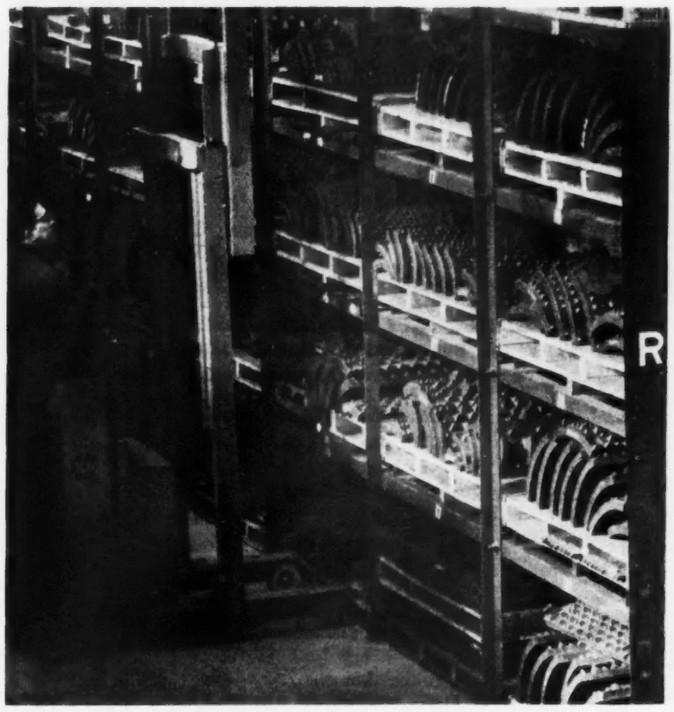
There are many other Miniature Micro Switches and Actuators besides the few illustrated here. All have the famous BURGESS long-life mechanism.

BURGESS PRODUCTS COMPANY LTD

MICRO SWITCH DIVISION

Dukes Way, Team Valley, Gateshead 11.
Telephone: Low Fell 75322 (3 lines). Télex: 53-229
London Office: 127 Victoria Street, S.W.1.
Telephone: TATE Gallery 0251 (3 lines)

Enter No. 221 on reply card



B.J-D give 'off-the-shelf' service for crusher spares

ONLY the manufacturer can supply the correct replacement part or spare. Genuine B.J-D crusher spares ensure that replacements fit properly and give the best results. Further, B.J-D Service Department is now organised to give an 'off-the-shelf' service, so there need be no delays to hold up your production. If you wish, you can telephone orders for spares to Wakefield 6041.

The range of B.J-D crushers:

- Rock Busters
- Mud Hogs
- Single Roll Breakers
- Double Roll Crushers
- Flextooth Crushers
- Pulverisers
- Granulators

and other crushers specially adapted to the needs of specific industries.

★ *The photograph above gives a glimpse of our Service Department's stock of crusher spares — segments for roll breakers.*

BJD Crushers

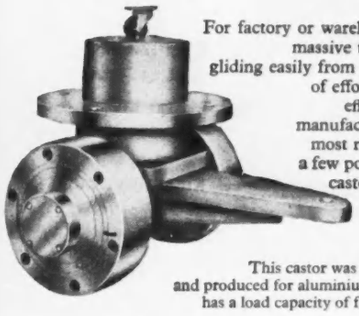
for industrial applications

BRITISH JEFFREY-DIAMOND LIMITED,
CRUSHER AND INDUSTRIAL DIVISION, 15-17, CAXTON STREET, LONDON, S.W.1.

WF 5124

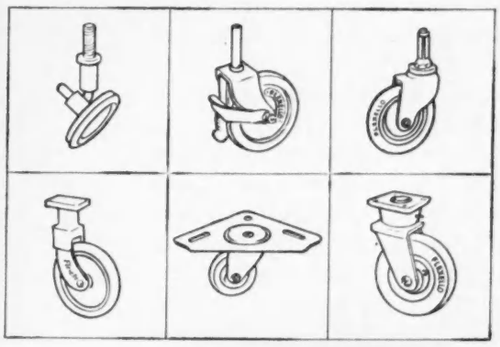
Enter No. 231 on reply card

MASSIVE OR MIDDLEWEIGHT . . .



For factory or warehouse. Huge mobile testing equipment, massive trollies, the lightest storage bin—all are gliding easily from place to place, moved with a minimum of effort. Industry is flowing smoothly, freely, efficiently—thanks to FLEXELLO, the largest manufacturer of castors in Europe. Made to the most rigid standards, to support weights from a few pounds to twenty tons, there's a FLEXELLO castor for every purpose—and if you want a 'special', FLEXELLO will design and make it.

This castor was specially designed and produced for aluminium production and has a load capacity of from 10 to 12 tons.



'44' SERIES CASTORS: A special series of *Double Ball Bearing* heavy medium duty castors, specially manufactured for export which have now become available for the home market.

everything flows freely on **Flexello** *constant quality castors*

For further particulars write for catalogue E

FLEXELLO CASTORS & WHEELS LTD. · SLOUGH BUCKS · TELEPHONE SLOUGH 24121

Enter No. 232 on reply card

When Production needs Punch . . .

. . . use top quality SWISS TIMERS

MODEL 2/DEC £6:17:6

MODEL 2/1/S £6:17:6

MODEL 2/DEC/1/S £8:5:0

Greater productivity is a national necessity. Prestons Ltd.—the largest suppliers of Stop-Watches to British Industry—can help by supplying "work-study" specialists with Swiss Timers—the finest quality jewelled lever Stop-Watches available, giving long and accurate service.

NOTE: None of our Watches is Ex-Government stock. ALL are brand new, guaranteed and "factory-fresh"

PRESTONS LTD.

HEUER AGENTS

INDUSTRY'S LARGEST STOP-WATCH SUPPLIERS

BOLTON · LANCS · TEL.: 876/7

ASK ABOUT OUR **PRESTEX** PRECISION-TESTED **TIMERS**

Send for our catalogues and price lists for both Swiss and Prestex Watches. Send today.

Enter No. 233 on reply card

BARR THOMSON & Co., Ltd.

NETHERTON IRON WORKS, KILMARNOCK, SCOTLAND

Grams and Cablegrams: "BARR KILMARNOCK"

Telephone: KILMARNOCK 791

We Manufacture

DISHED AND FLANGED DRUM ENDS.
FLAT AND FLANGED TANK ENDS.
FLANGED COMPENSATING PLATES.
FLAT COMPENSATING RINGS.
EMBOSSED MANHOLE DOORS.
SINGLE FLANGED NOZZLES.
DOUBLE FLANGED STANDPIPES.
PIPE LINE FITTINGS INCLUDING BENDS, TEES, CROSSES, REDUCERS, CAPS, SADDLES AND SLEEVES.
PIPE LINE FLANGES, SLIP-ON WELDING NECK AND BLANK.
MISCELLANEOUS PRESSINGS AND FORGINGS.

London Office:—
10, NORFOLK STREET, LONDON, W.C.2
Telegrams: TUBENPIPE, PHONE, LONDON
Telephone: COVENT GARDEN 0315/6/7

Enter No. 241 on reply card

THE AIR OPERATED

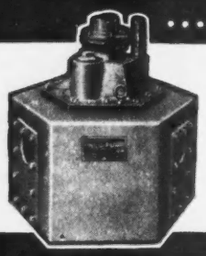
PNEU PUMP

NO MECHANISM NO SERVICING

ANYTHING THAT WILL FLOW

WATER, OIL, MUD, ABRASIVE MATERIALS, ACID, TAR, ETC.

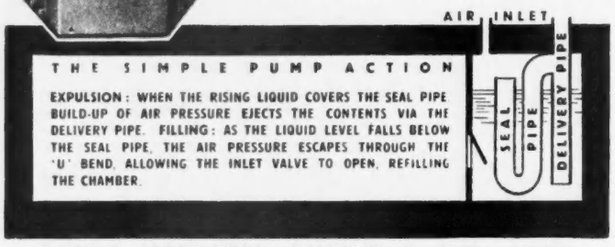
.... IT WILL PUMP!



Steel and corrosion-resisting models are held in stock for IMMEDIATE DELIVERY

OVER ONE-THIRD SALES ARE REPEAT ORDERS!

WE ILLUSTRATE THE STANDARD MODEL

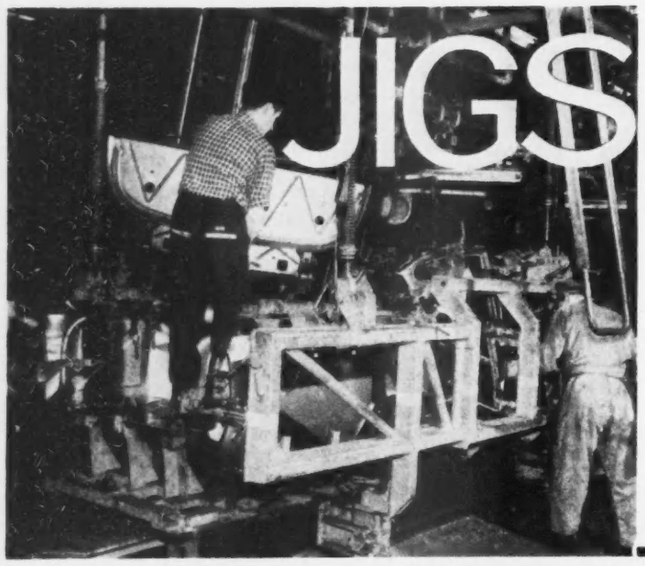


THE SIMPLE PUMP ACTION

EXPULSION: WHEN THE RISING LIQUID COVERS THE SEAL PIPE BUILD-UP OF AIR PRESSURE EJECTS THE CONTENTS VIA THE DELIVERY PIPE. FILLING: AS THE LIQUID LEVEL FALLS BELOW THE SEAL PIPE, THE AIR PRESSURE ESCAPES THROUGH THE 'U' BEND, ALLOWING THE INLET VALVE TO OPEN, REFILLING THE CHAMBER.

AMES CROSTA MILLS & CO. LTD.
HEYWOOD, LANCASHIRE
London Office: Abbey House, Victoria Street, London, S.W.1.
CW 3336.

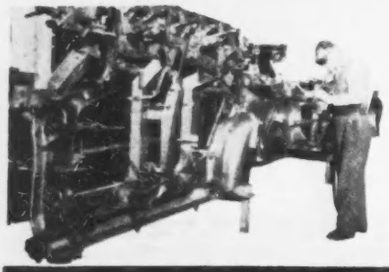
Enter No. 242 on reply card



& TOOLS

We specialise in the design and production of jigs and tools to extreme accuracy. A highly qualified staff is always available and at your service.
Get in touch with us.

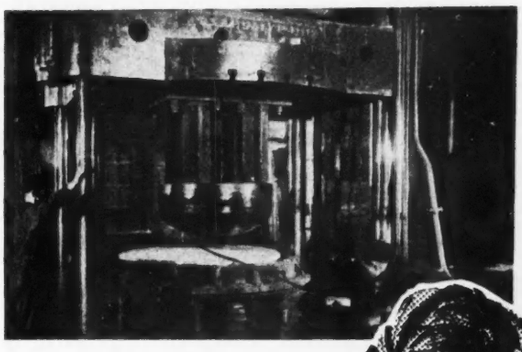
BIRMINGHAM & BLACKBURN Construction Co. Ltd.



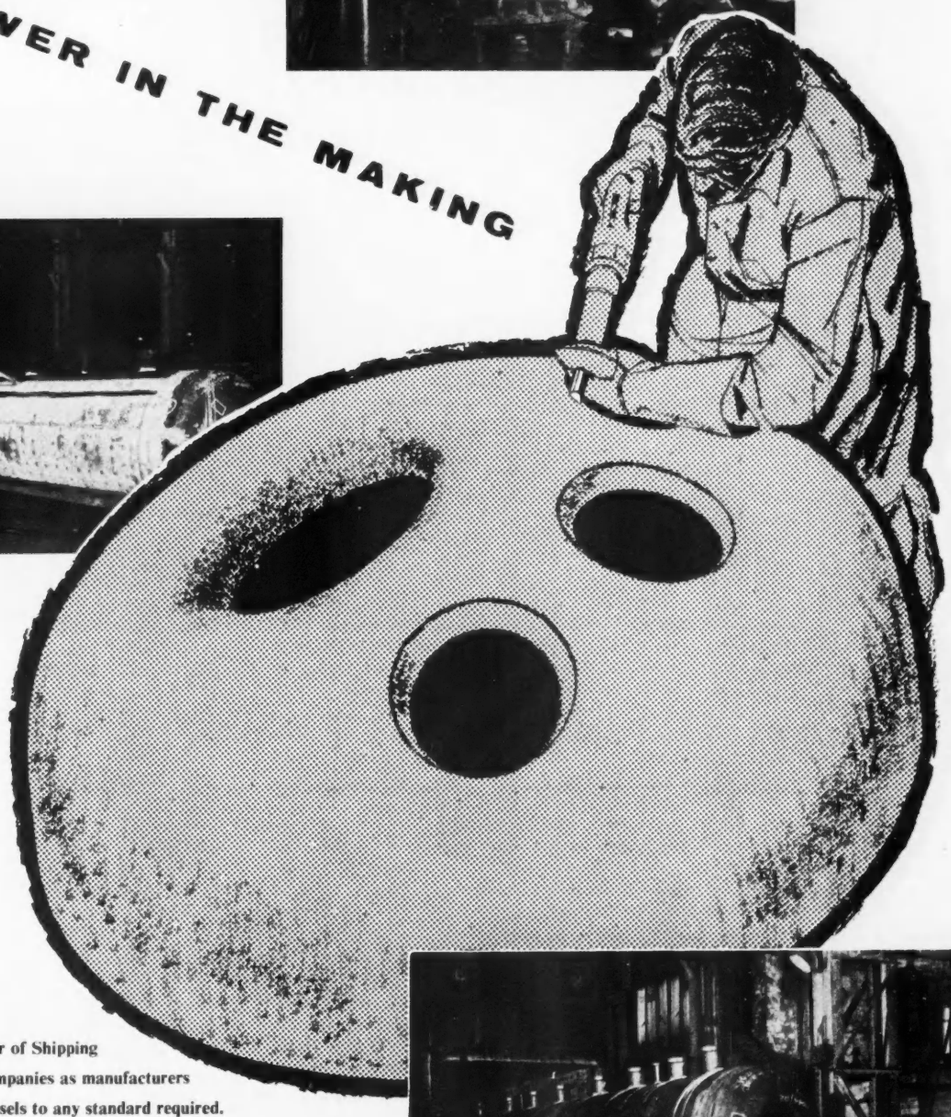
ARMOURY CLOSE, BORDESLEY GREEN, BIRMINGHAM 9.

AND AT GEORGE ST. WEST, BLACKBURN.

Enter No. 243 on reply card



POWER IN THE MAKING



Accepted by Lloyd's Register of Shipping
and all leading insurance companies as manufacturers
of fusion welded pressure vessels to any standard required.

CLARKE, CHAPMAN & CO. LTD.
Victoria Works · Gateshead, 8 · Co. Durham
LONDON Dunster House, Mark Lane, London E.C.3.
GLASGOW 116 Hope Street, Glasgow C.2.
MANCHESTER 8 King Street, Manchester, 2.

Clarke Chapman

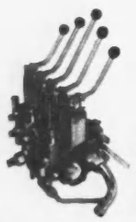
STEAM GENERATING PLANT FOR INDUSTRY

Enter No. 251 on reply card

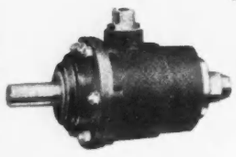
SPENBOROUGH *Hydraulics*

FOR SPECIAL APPLICATIONS

Double Acting Hydraulic Rams *with special end fittings*



Series Group Control Valve Type 872. Up to 25 g.p.m. at 2,000 lb./p.s.i. Positive Control. Spring return to levers. Master and auxiliary relief valves incorporated



Rotary Swash Plate Pump with 4, 6, 8 and 10 plungers

Single and Double Acting Hand Pumps

For almost forty years Spenborough have been in the forefront of the design, development and manufacture of hydraulic mechanisms. Our long experience in producing Rams, Pumps and Valves is freely available to all users of Hydraulic Systems and enquiries are invited for precision-built equipment of the highest efficiency.

SPENBOROUGH ENGINEERING CO. LTD.

HECKMONDWIKE, YORKS.

Phone: Heckmondwike 924 5 Grams: UNION

London & S.E. Counties: B. B. SALES LTD., 88 CLAPHAM RD., LONDON, S.W.9 Phone and Grams: Reliance 2512

Enter No. 261 on reply card

Holes made by Clarkson Drills are the type that bring an appreciative nod from the most fastidious inspector. For there's no doubt about it, Clarkson Drills are already achieving the high reputation set by Clarkson Chucks and Cutters. No ordinary drills these. They have the extra inbuilt quality that makes better, cleaner, more accurate holes at greater speed. They are better drills, made to give longer life between regrinds.

Buy Clarkson with confidence—you cannot use a better drill. Sold only through Clarkson branches to ensure instant delivery.

"Better holes look up to Clarkson Drills"

Clarkson Drills

through and through — they're Clarkson

Branches at
BELFAST Tel.: 20025. LEEDS Tel.: 26369. NEWCASTLE Tel.: 2-5248. LONDON RIVerside 8241. BIRMINGHAM VICtoria 3994. BRISTOL Tel.: 2-8464. GLASGOW SOUth 1942. MANCHESTER ARDwick 4804.

CLARKSON (ENGINEERS) LTD., NUNEATON. Tel.: 2261

Please send for literature giving details of Clarkson Drills and prices.

Name.....

Address.....

A .....

Enter No. 271 on reply card

. . . feel safe in the knowledge that with a PRATT machine you have the best possible materials, the utmost degree of accuracy, the greatest margin of safety.

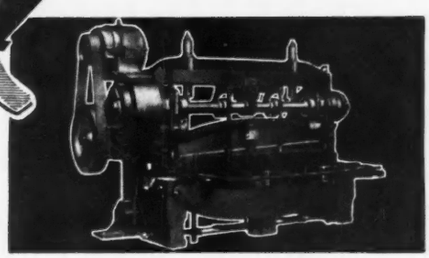
insist on

GUILLOTINES

BAR SHEARS, OPEN FRONTED PRESSES

BY

PRATT BROTHERS (STOURBRIDGE) LTD.



ENVILLE ST., STOURBRIDGE

Telephone · 4211

Established · 1902

Enter No. 272 on reply card

rotary positive blowers

gas boosters

vacuum pumps

vapour compressors

Manufactured to standard or unusual demands by

Hillside Foundry & Engineering Co. (Cupar) Ltd.

Sole licensees in Great Britain and the Commonwealth for the

Sutorbilt Corporation U.S.A.

already operating in the following industries:

CHEMICALS · FOOD
COTTON · OIL
AIRCRAFT · FILMS
WASTE & SEWAGE
FOUNDRIES
CONSTRUCTION MINING

Send your enquiries to:

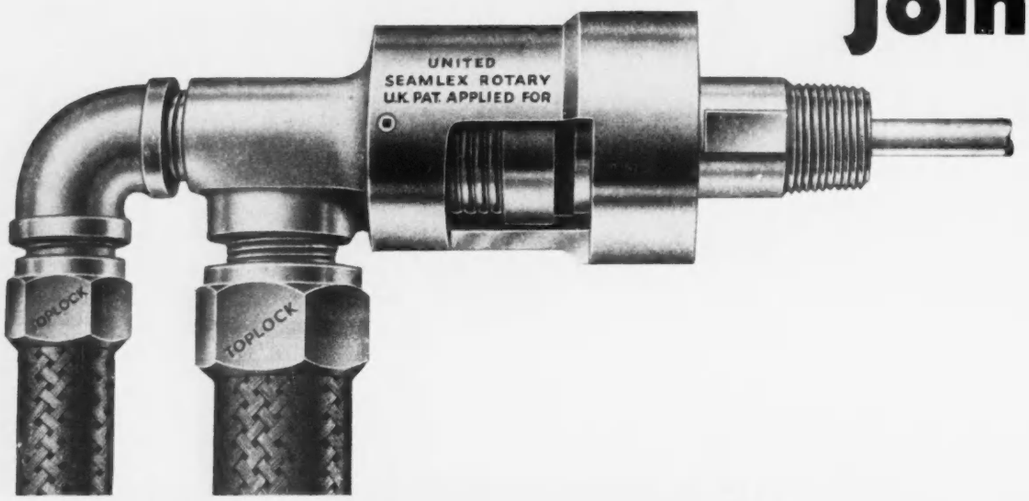
HILLSIDE FOUNDRY & ENGINEERING CO. (Cupar) LTD.

Hillside Foundry, Cupar, Fife

Tel: Cupar 2091/2

Enter No. 273 on reply card

The United Seamlex Rotary Joint



FOR STEAM, WATER, AIR, VACUUM

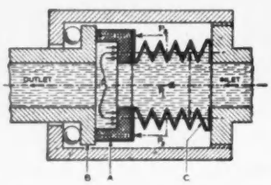
The Seamlex Rotary Joint is light in weight, compact, easy to install, easy to repair and economical.

The United Seamlex Rotary Joint is manufactured under licence from The Seamlex Company of Long Island City, New York.

with Triple Protection against Leakage

1 PRESSURE EQUALIZING CHAMBER

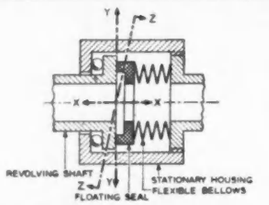
UNITED SEAMLEX ROTARYS maintain their steady leak-proof performances under higher pressures because . . . regardless of the pressure in the supply line, the Pressure Equalizing Chamber automatically *reduces* the pressure to the minimum required for continuous, leakproof operation. The automatically *reduced* pressures cause less friction, prolonging the life of the seal, as well as the rotary shaft, thus providing effective protection against leakage.



PRESSURE DIAGRAM
How working pressure P_1 + spring (Bellows) pressure P_2 is reduced by counterpressure P_3

2 FLOATING GRAPHITE SEAL

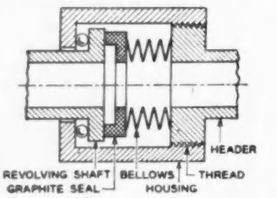
The Seamlex *Floating* Seal, being flexibly mounted by means of a metallic bellows, is self-aligning, permitting it to move freely in any direction, axially as well as radially and obliquely. The *Floating* Seal absorbs smoothly the impact that is exerted upon it by a misaligned revolving shaft.



FLOATING SEAL
Self-aligning in any direction, axially X–X, radially Y–Y and obliquely Z–Z.

3 EXTERNAL PRESSURE ADJUSTMENT

This third exclusive feature contributes further to the continuous leakproof performance of United Seamlex Rotarys because . . .
It permits compensating for wear of graphite seal before leakage occurs—*without removal* of Seamlex Rotary from service.
Predetermined factory-adjustment—to meet your particular working pressure—eliminates excessive wear of seal and shaft.



SCREW ADJUSTMENT
The threaded engagement between header and housing permits the relative movement required for wear compensation and pressure regulation.

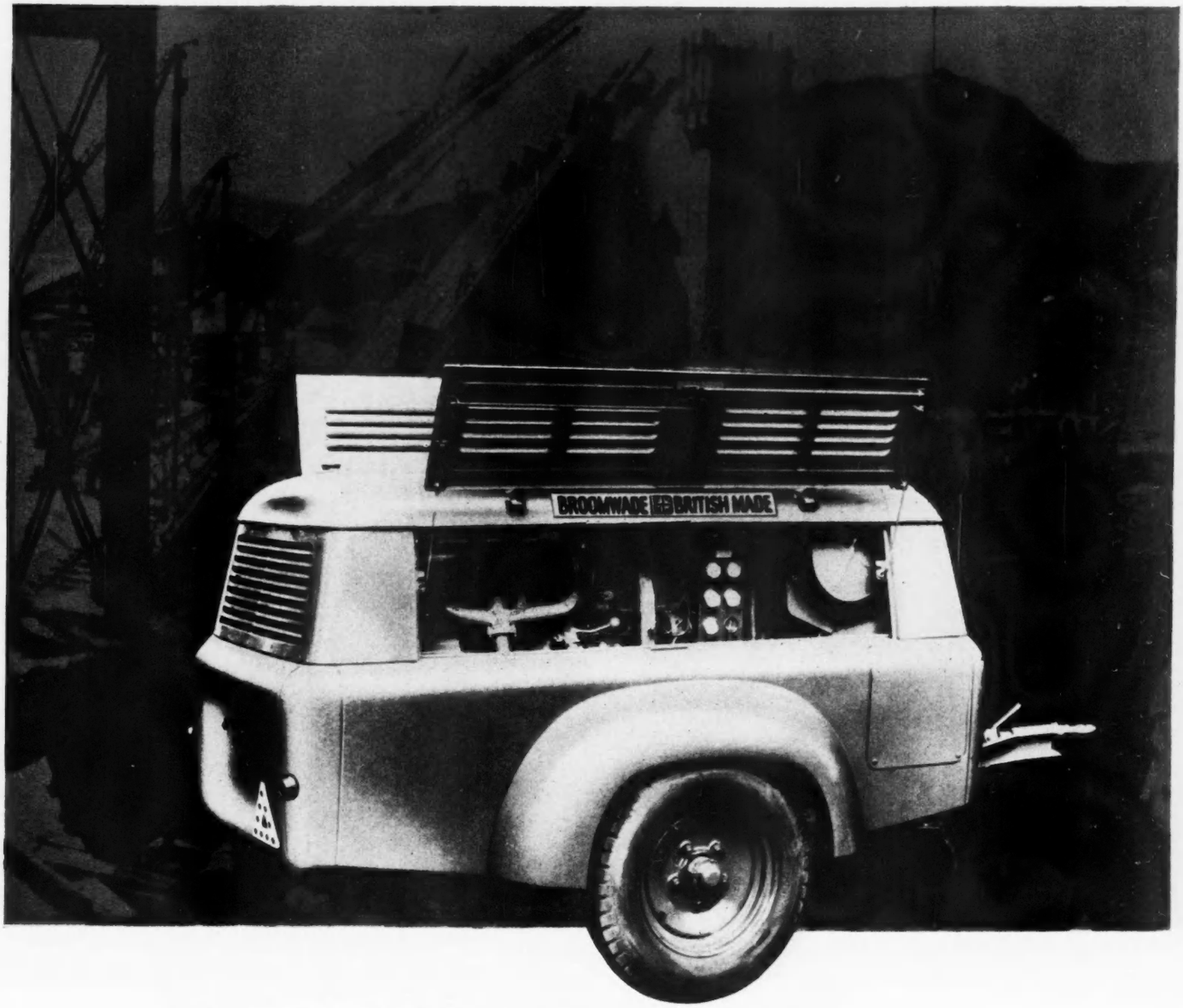
UNITED FLEXIBLE METALLIC TUBING CO. LTD.

KINGS BOURNE HOUSE, 229-231 HIGH HOLBORN, LONDON, W.C.1

TELEPHONE CHA 6705

WORKS - PONDERS END, ENFIELD · MIDDLESEX Telephone : HOWARD 1881

Enter No. 281 on reply card



Power for Industry

Man has learned to harness water power for industry. Dams, hydro-electric projects are under construction in all parts of the world. In these projects compressed air is playing an important part.

Civil Engineers demand reliable plant in order to complete contracts to schedule.

It is significant that they specify " BROOMWADE " Air Compressors and Pneumatic Tools for they are fully aware of "BROOMWADE" EFFICIENCY, ECONOMY and RELIABILITY.

Illustrated is the WR 120 Rotary Air Compressor delivering 120 c.f.m. at 100 lbs sq. in.

Write now for publication No. 333 *R.C.E., giving details of the complete range of Rotary Compressors — capacities from* 120-630 *c. f. m.*

"BROOMWADE"

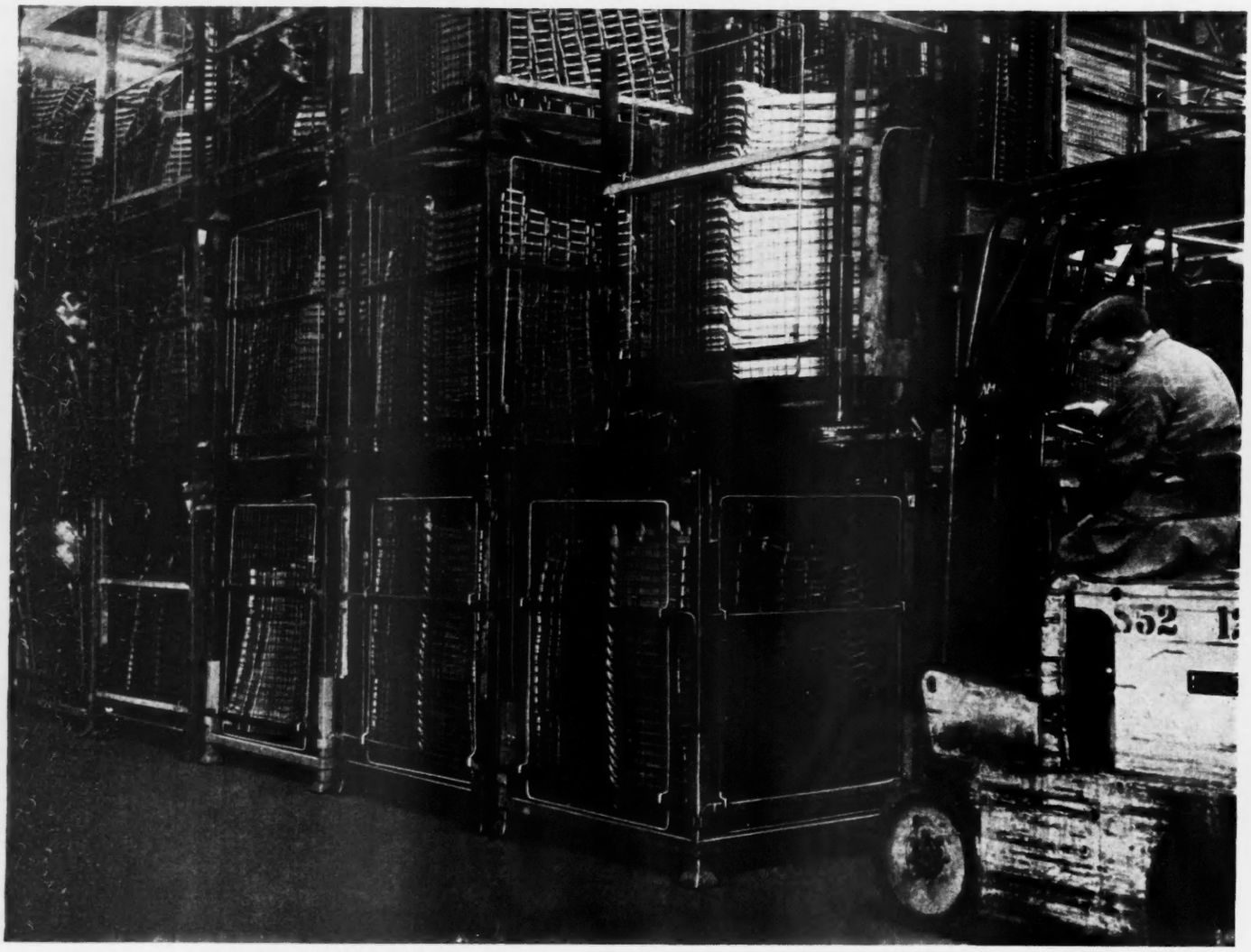
AIR COMPRESSORS & PNEUMATIC TOOLS

YOUR BEST INVESTMENT

BROOM & WADE LTD., P.O. BOX No. 7, HIGH WYCOMBE, ENGLAND. *Telephone: High Wycombe 1630 (10 lines)* *Telegrams: "Broom", High Wycombe (Telex)* 674 SAS

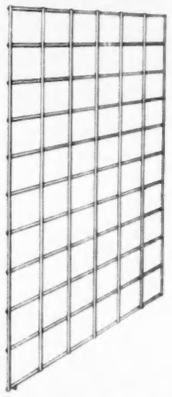
Enter No. 291 on reply card

Weldmesh in use



...for mechanical handling

Weldmesh is the ideal material for retaining smaller components in post pallets and for racking, partitioning or machinery guards, etc. Cut it to the shape you want—it holds together because it is welded together. In the Weldmesh list of standard sizes you will find a mesh size and wire gauge to suit every purpose. A technical service is available to handle any problems.



Weldmesh is a registered trade name and is supplied direct to users by the sole manufacturers :

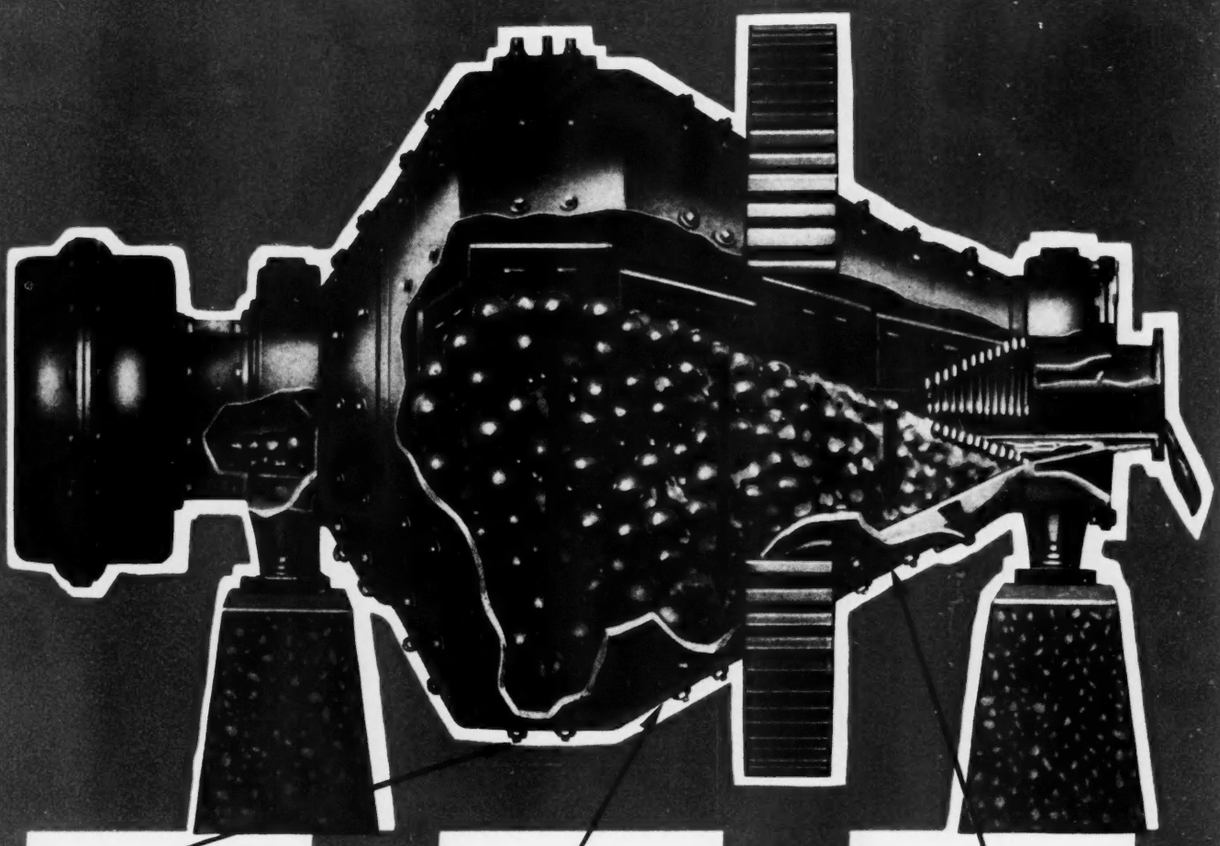
THE B.R.C. ENGINEERING COMPANY, STAFFORD

London, Birmingham, Bristol, Leeds, Leicester, Liverpool, Manchester, Newcastle, Cardiff, Glasgow, Dublin, Belfast, Bulawayo, Calcutta, Johannesburg, Singapore, Vancouver.

Export Sales : 54 Grosvenor Street, London, W.1

Enter No. 301 on reply card

THE HARDINGE CONICAL MILL



ZONE 1
4-in. balls. 3-ft. drop. Energy 28-ft. lbs.

ZONE 2
3-in. balls. 2-ft. drop. Energy 8-ft. lbs.

ZONE 3
2-in. balls. 1-ft. drop. Energy 1-ft. lb.

Lower Power Consumption— Less Wear

Hardinge conical mills installed throughout the world are handling vast tonnages. The principle of segregated grinding in zones ensures maximum efficiency and economy of operation. Recommendations are made to suit specific applications. For fuller details please apply for brochure number G.525.

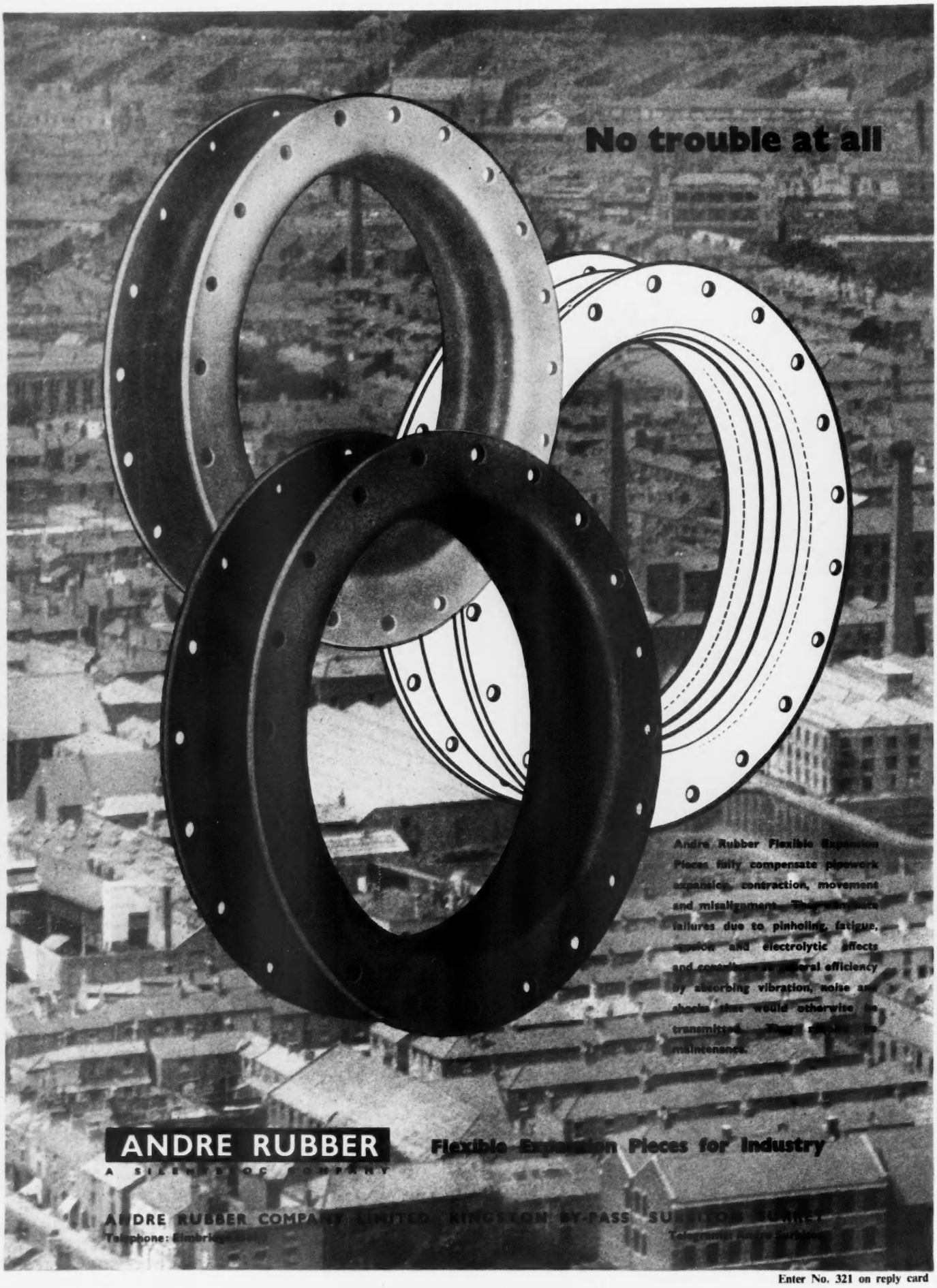
INTERNATIONAL COMBUSTION PRODUCTS LIMITED

Member of Atomic Power Constructions Ltd. One of the five British Nuclear Energy Groups

LONDON OFFICE: NINETEEN WOBURN PLACE, W.C.1 TELEPHONE: TERMINUS 2833 WORKS: DERBY

TGA 411

Enter No. 311 on reply card



Enter No. 321 on reply card

Custom-built Engines

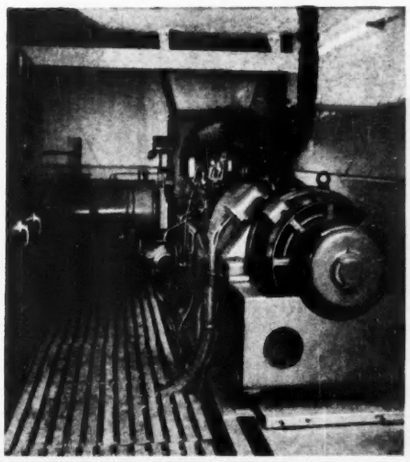
All over the world you will come across Mercedes-Benz diesel engines — on building sites or in industrial plants, in harbour installations, in mining plants or in hospitals.

There are three good reasons for this: Firstly, the Mercedes-Benz engine programme comprises 24 types, with horsepowers ranging from 17 to 3000 b. h. p., so that it meets every power requirement occurring in practice.

Secondly: Mercedes-Benz diesels — water-cooled four stroke designs with precombustion chamber, of vertical or horizontal in-line types or of V arrangement, supercharged or unsupercharged — are as powerful, dependable and durable as all Mercedes-Benz products.

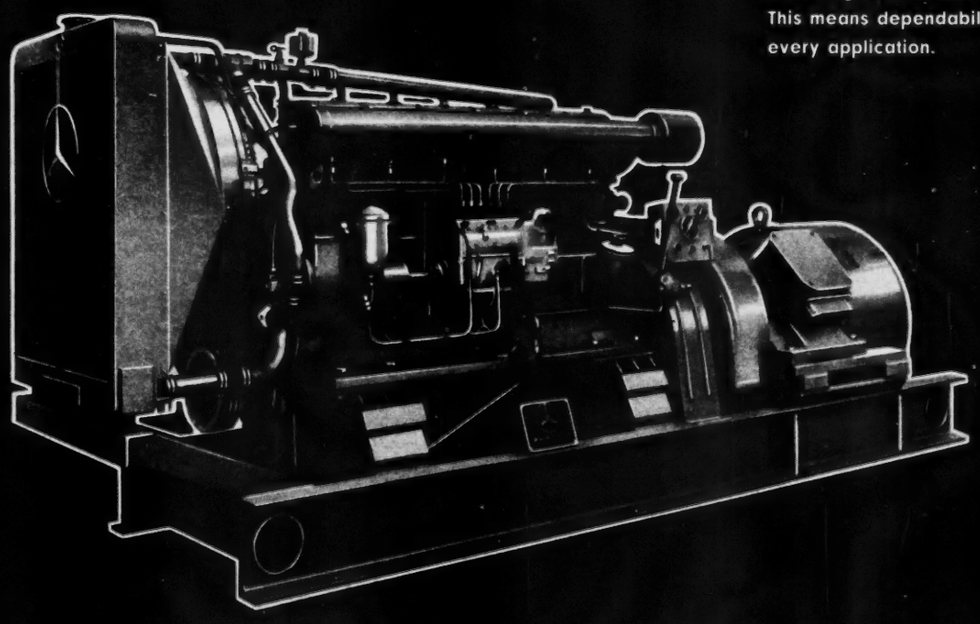
And thirdly: At hundreds of service stations scattered all over the world there are skilled mechanics to keep every Mercedes-Benz diesel operating at top performance.

Mercedes-Benz diesels therefore offer all the properties required for economical and reliable operation.



Quality is dependable

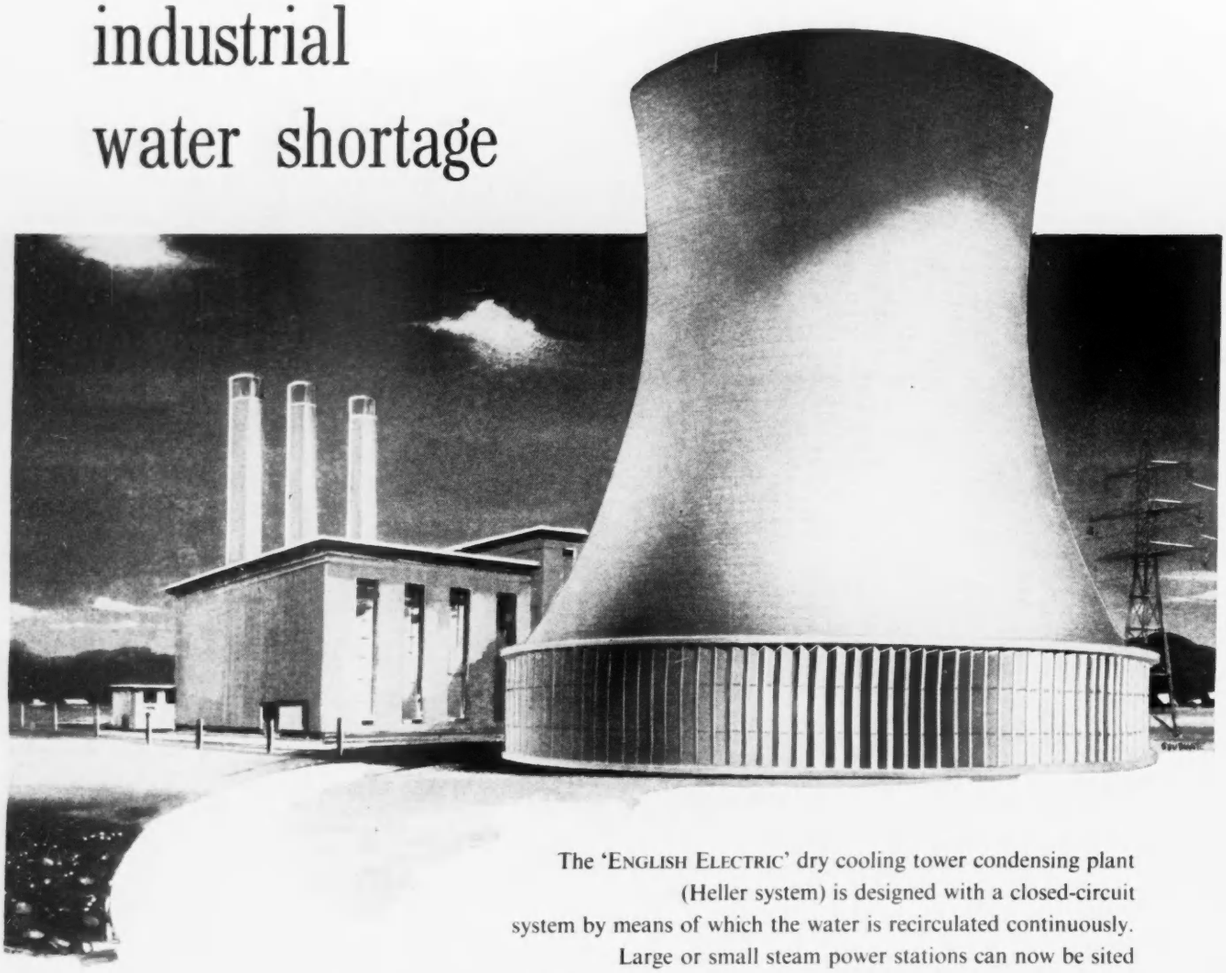
Mercedes-Benz diesel engines have many good qualities: They supply a maximum of power for a minimum of fuel; their simple, rugged design makes for easy maintenance, and they will retain their high performance over a long period of years. But their most important advantage is their outstanding quality: This means dependability for every application.



974 MAi

MERCEDES-BENZ DIESEL

DRY cooling tower installations overcome industrial water shortage



The 'ENGLISH ELECTRIC' dry cooling tower condensing plant (Heller system) is designed with a closed-circuit system by means of which the water is recirculated continuously. Large or small steam power stations can now be sited independently of large sources of water for condenser cooling.

A publication "Dry Cooling Tower Condensing Plant" is available on application to The English Electric Co. Ltd., Steam Turbine Division, Rugby.

'ENGLISH ELECTRIC'

THE ENGLISH ELECTRIC COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2

WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

ST. 35

Enter No. 341 on reply card

DEMAG

Outstanding for its particularly economic operation among the compressors of DEMAG's comprehensive manufacturing programme is the four-stage turbo compressor, which has two shafts. This compressor, designed for inlet capacities of 5,000 to 30,000 cfm at pressure ratios between 5 and 15, is built for compressing air.

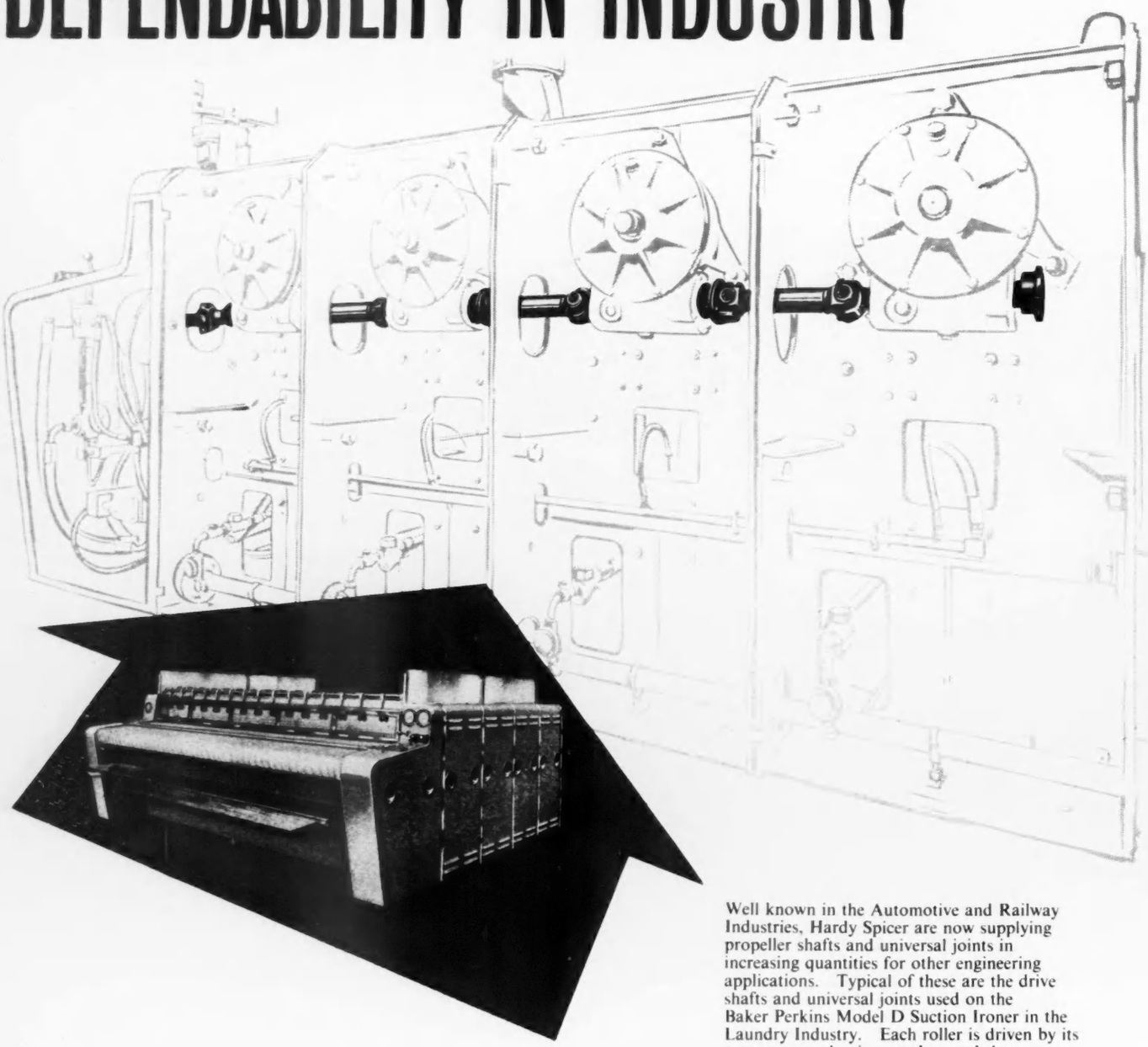
Four DEMAG four-stage turbo compressors:
Total inlet capacity 28,300 cfm, discharge pressure 113 psig.

For U. K. represented by:
William H. Capper & Co. Ltd., 8/9, Hertford Street, London W1

DEMAG AKTIENGESELLSCHAFT DUISBURG GERMANY

Enter No. 351 on reply card

DEPENDABILITY IN INDUSTRY



Well known in the Automotive and Railway Industries, Hardy Spicer are now supplying propeller shafts and universal joints in increasing quantities for other engineering applications. Typical of these are the drive shafts and universal joints used on the Baker Perkins Model D Suction Ironer in the Laundry Industry. Each roller is driven by its own worm reduction gearbox and these are coupled together by double universal joints to form a drive shaft. Hardy Spicer's wide experience ensures the highest standards of design and performance. Please write for further details and illustrated leaflets.

HARDY SPICER

PROPELLER SHAFTS

Product of the Birfield Group

HARDY SPICER LIMITED

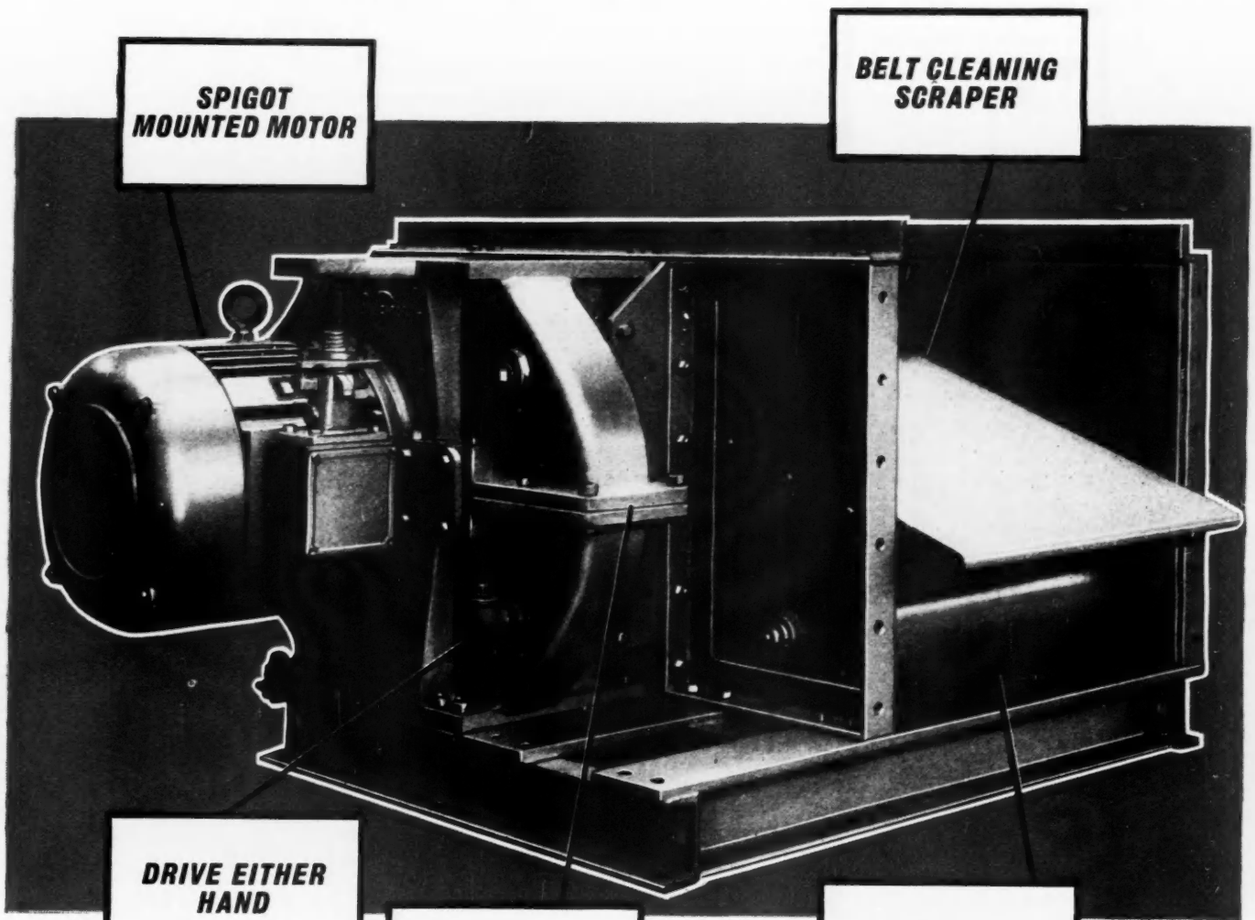
CHESTER ROAD · ERDINGTON · BIRMINGHAM 24 · TELEPHONE: ERDINGTON 2191 (18 LINES)

Engineering Division of BIRFIELD INDUSTRIES LIMITED, Stratford House, W.1

Enter No. 361 on reply card

Economy *in Operation* IS DESIGNED

IN THE *PANTHER* HEAVY DUTY DRIVING HEAD



The Panther is one of a range of heavy duty industrial type belt conveyor driving heads. Expert attention has been given to economy of operation. Built-in hold-back is available if required.

Send for a copy of our 'Panther' leaflet quoting ref. EN/28

Britain's Best Conveyors

RICHARD SUTCLIFFE LTD · HORBURY · WAKEFIELD

Sutcliffe

dm RS 20

Enter No. 371 on reply card

IF YOU CUT, GOUGE, BEVEL or GROOVE Metals – THE *Arcair* TORCH will save you money!

Using only an electric arc and compressed air, the Arcair Torch is the new, efficient and money-saving answer to most metal removing problems. Whether used as a production or maintenance tool, the patented Arcair Torch saves up to 60% over other metal removing methods.

For further information on the Arcair Torch and a demonstration of how this money-saving tool can bring economies in YOUR works, please write to:

LINCOLN ELECTRIC CO. LTD.

BLACK FAN ROAD · WELWYN GARDEN CITY · HERTS

TELEPHONE: WELWYN GARDEN 920/4 · 4581/5

GKN

AA1&A

Enter No. 381 on reply card

SCHIESS
MACHINE TOOLS

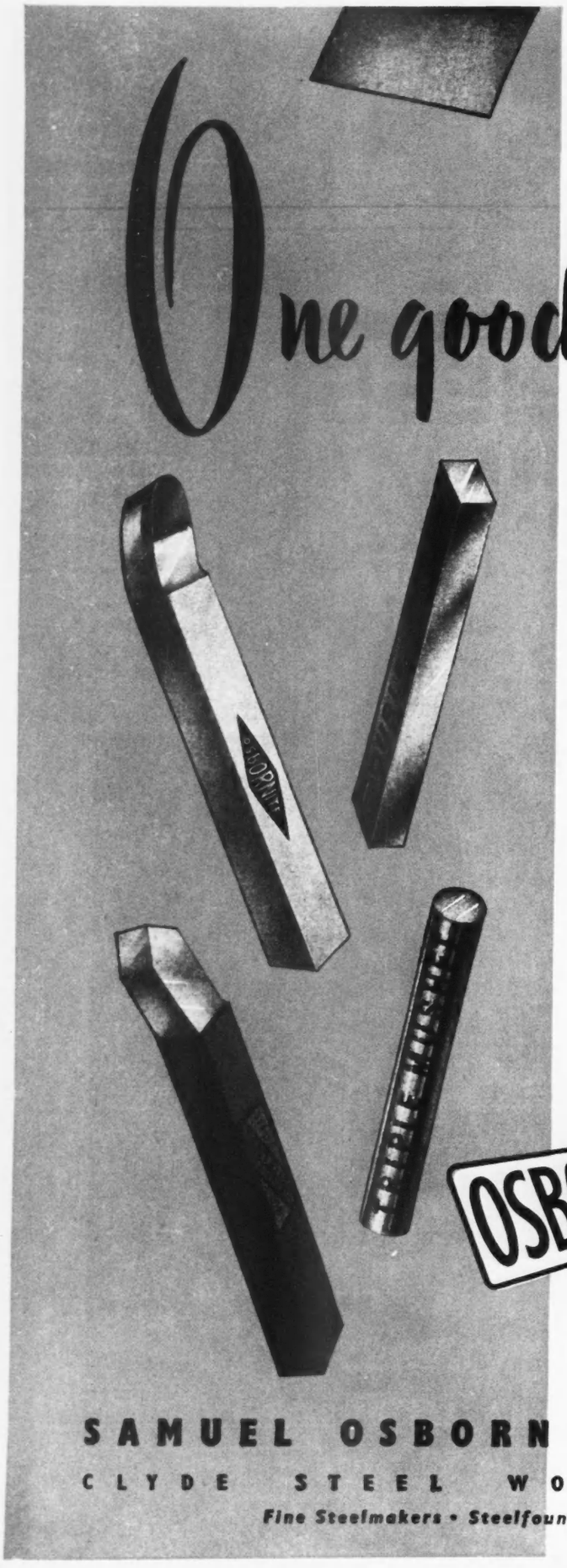
Our Programme :—

Single and Double Column Vertical Boring Mills
Vertical Tyre Boring Mills
Horizontal Boring and Milling Machines
Horizontal Milling and Boring Machines
Plano-Millers
Vertical Cylinder Boring Mills
Precision Gear Hobbing Machines
Gear Shaping Machines
Crankpin Turning Machines
Crankshaft Milling Machines
Rotor Slot Milling Machines
Automatic Lathes
Ships Frame Bevelling Machines
Special Type Machine Tools

SCHIESS AKTIENGESELLSCHAFT · DÜSSELDORF

Agents United Kingdom and Eire. **BURTON, GRIFFITHS & CO. LTD. BIRMINGHAM**
SYKES MACHINE TOOL CO. LTD. THE HYTHE, STAINES, MIDDLESEX
(For Gear Manufacturing Machines)

Enter No. 391 on reply card



One good turn...

Do your operators a good turn by providing them with *Osborn* cutting tools and you will do yourself a good turn by increasing efficiency and output.

An extensive range of lathe and planer tools in solid or butt-welded high-speed steel and *Osbornite* hard metal, together with toolholder bits, are manufactured under carefully controlled conditions and inspected at every stage to ensure maximum quality.

Comprehensive stocks constantly maintained

OSBORN

If you are using the new

"MUSHET SPECIAL" **'VG'** HIGH-SPEED STEEL

you will know how good it is—if not please ask for details.

Available as:

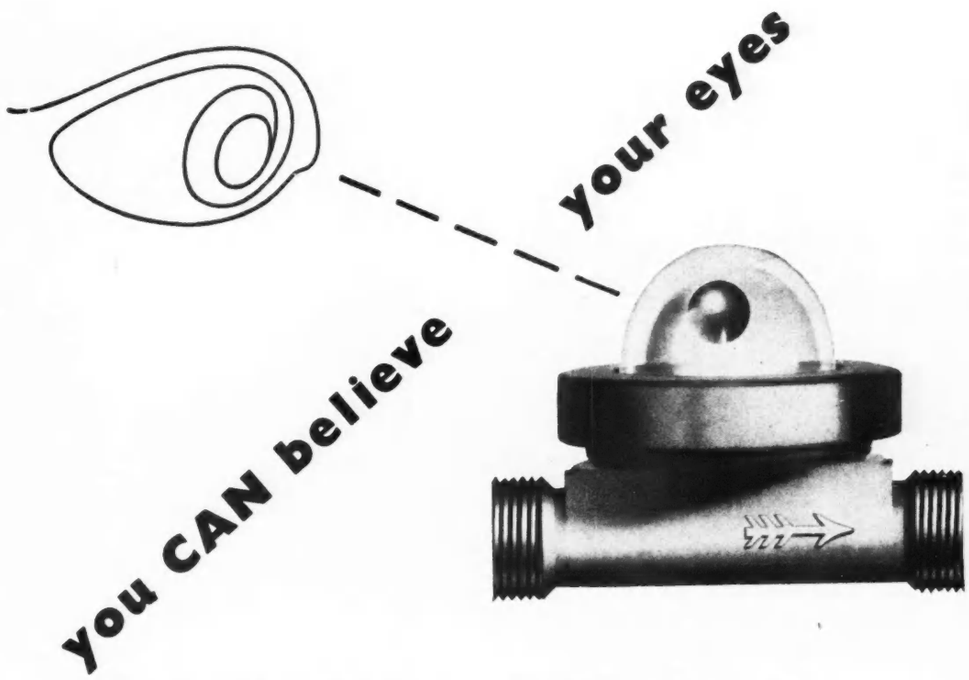
lathe and planer tools, toolholder bits, bars and blanks.

SAMUEL OSBORN & CO., LIMITED.

CLYDE STEEL WORKS, SHEFFIELD.

Fine Steelmakers • Steelfounders • Engineers' Toolmakers

Enter No. 401 on reply card

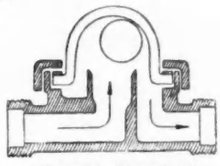


You don't need second sight when a 'SHOFLO' is in the line.

Where circulating water systems are concerned, for radiators, condensers, liquid vats, oil coolers, radio transmitting equipment and the like, a 'SHOFLO' Indicator is the perfect answer when you've got to tell *at first sight* whether the coolant is flowing or not.

LOW FLOW

A whirling ball under the toughened glass dome indicates passage of clear or translucent liquids at flows as low as 4 g.p.h., pressures up to 100 p.s.i. Standard casing is aluminium bronze for ¼" sizes, gunmetal for 1½" sizes; other metals for alkaline or acidic fluids.



HIGH FLOW

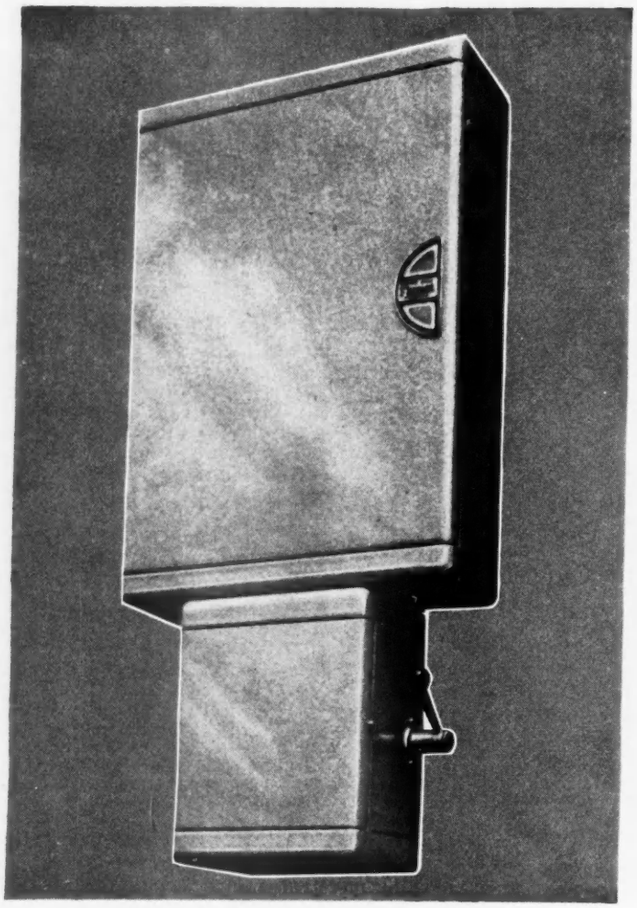
Available in two sizes: Nominal ½" and 1½" bores for flows up to 2,000 g.p.h. ½" size also made with right angle inlet and outlet.

SHOFLO
tells at a glance

MEASUREMENT LTD., Tameside Works, Dobcross, Near Oldham. Tel.: Delph 424 (5 lines)
EXPORT ENQUIRIES to: Parkinson Cowan Group Exports Ltd
Terminal House, Grosvenor Gardens, London, S.W.1.
Telephone: SLOANE 0111/4 Cables: DISC, London
A Parkinson Cowan Company

Enter No. 411 on reply card
F

AEROFLEX Fluvent



CABINET STYLE DISTRIBUTION BOARDS

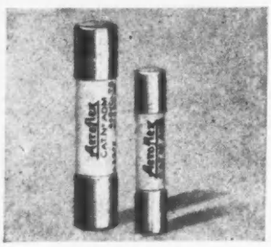
Widespread acceptance of surface mounting Fluvent Cabinet Style Boards has resulted in the production of Switches of similar exterior, intended principally for use as control switches mounted in conjunction with the boards. Both boards and switches have pressed steel cabinets which are cadmium plated and painted to give a grey metallic hammer finish.

The range has been further reinforced by the production of boards for recessed mounting, illustrated right. They are designed to allow the main body of the board to be sunk into a wall cavity of appropriate depth; the plasterwork and wall finish are then made up to the surrounding surface plate provided.

Aeroflex

ENERGY LIMITING FUSES

Fluvent Cabinet Style Distribution Boards are fitted with Aeroflex Energy Limiting High Breaking Capacity Rewireable Cartridge Fuses to BS.88-1952 Cat. 440 AC5 Class P. Standard fully wired cartridge fuse links are included unless otherwise specified, when appropriate underwirings can be fitted.



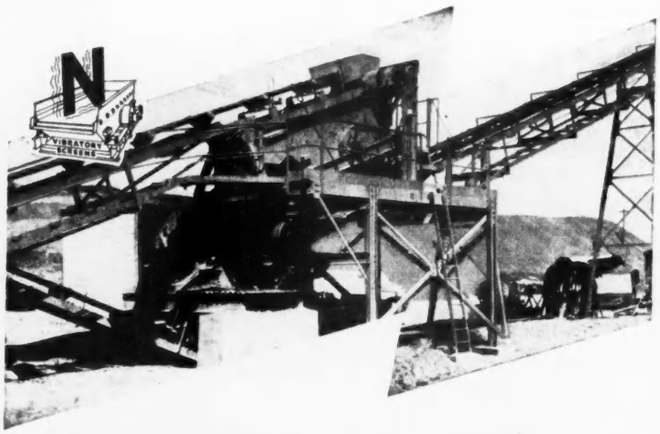
Parmiter Hope & Sugden Limited, **MANCHESTER, 12.**

London: 34 VICTORIA STREET, S.W.1. **Glasgow: 5 SOMERSET PLACE, C.3.**

Birmingham: 39/41 CARRS LANE, 4.

dm PH 130.

Enter No. 421 on reply card



Mechanical Handling
by NIAGARA

Every type of mechanical handling equipment is manufactured and installed by Niagara Feeders, Conveyors, Hoppers. Niagara go further, they have the experts and the know-how to design mechanical handling plant to meet all the conditions of your work and site. Niagara designed, manufactured and installed the plant illustrated. It is proving a profitable buy for its owner.

NIAGARA

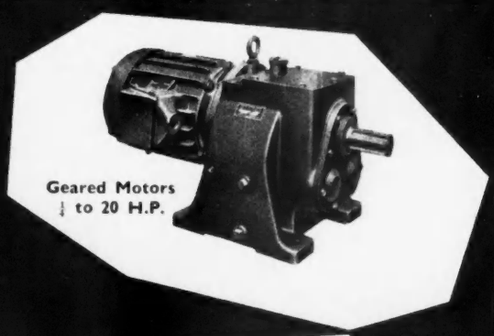
SCREENS (Great Britain) LTD.

STRAYSFIELD ROAD, CLAY HILL, ENFIELD, MIDDLESEX

Telephone: **Enfield 6622 (4 lines)**

Enter No. 431 on reply card

RAYNER POWER DRIVES



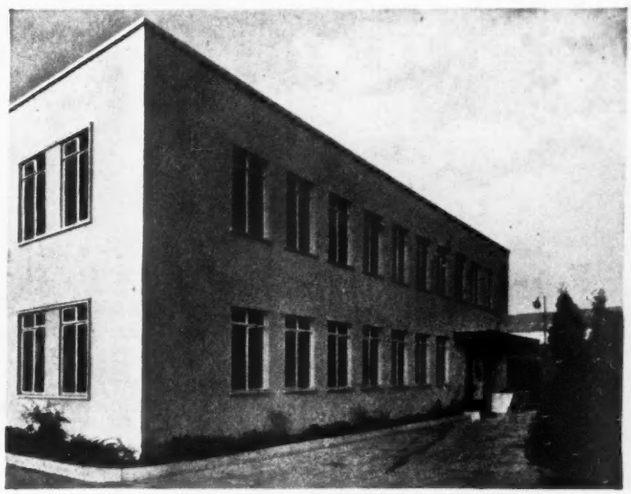
Compact purpose-made power drives are our business

PETER RAYNER LTD RAYNER

121 WHITEHALL RD · LEEDS 12 *Telephone:* **LEEDS 33864/5**

Enter No. 432 on reply card

Streamlined SERVICE



BECAUSE we have equipped and staffed our organisation technically and specifically to deal with ***all*** *the problems of modern metal cleaning, we are able to provide the right process and the right product to meet any unusual requirement. Consultation with "S.A.C." technicians is the streamlined way of getting the answer which saves you time and cost.*

PRODUCTION PROVED PRODUCTS

SUNBEAM ANTI-CORROSIVES LTD.

CENTRAL WORKS · CENTRAL AVENUE
WEST MOLESEY · SURREY

Telephone: Molesey 4484 (5 lines)
Telegrams: Sunanticor, East Molesey

Manufacturers of

STRIPALENE · FERROCLENE · ALOCLENE · FERROMEDE · BRAZOCLENE

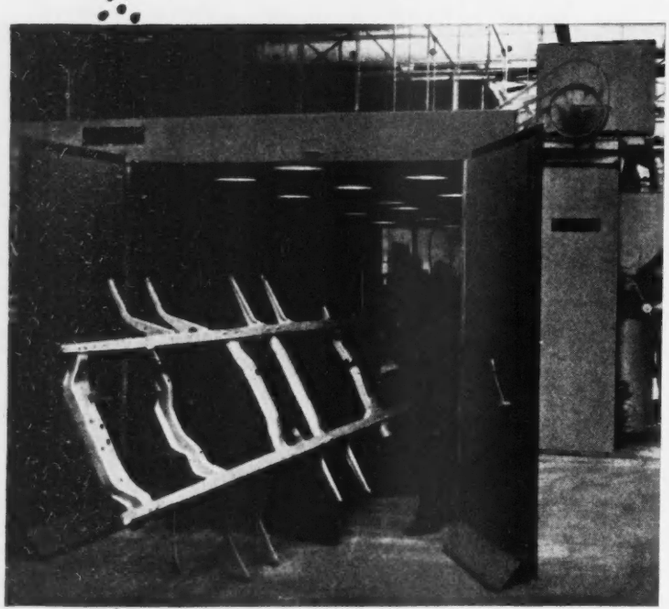
(Regd. Trade Marks)

APPROVED BY ADMIRALTY, WAR OFFICE AND AIR MINISTRY

Enter No. 433 on reply card

St. Georges

SHOT BLAST ROOMS



We make all types of wheel or compressed air plants

over 50 years' experience embodied in design and manufacture

St. Georges Engineers Ltd

Ordsall Lane Trafford Bridge Manchester 5

Telephone: Trafford Park 1207 (4 lines) Telegrams: 'Georgic' Manchester 5

Enter No. 441 on reply card

HIGH DUTY GEARING

with hardened and ground tooth flanks for—

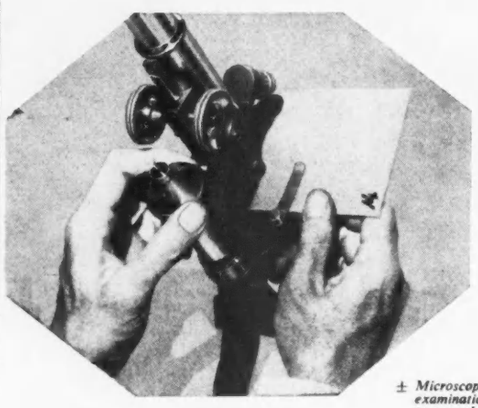
RAIL VEHICLES
TRACTORS
MECHANICAL HANDLING
INSTALLATIONS

HEINRICH REINING G.M.B.H.

ZAHNRADFABRIK VELBERT

Head Office: DUSSELDORF, MALKASTENSTR. 5 Telefon: 10741 Telex: 0858 2542

Enter No. 442 on reply card



± *Microscopic examination test panel*

Are these hands helping *you?*

These are the hands of a chemist in a Pinchin Johnson paint testing laboratory, ensuring that material complies exactly with the required specification. Technical service from start to finish is the basis of P.J. leadership in the supply of paint to industry. This service is effectively yours through your nearest P.J. branch.

PINCHIN JOHNSON & COMPANY

HEAD OFFICE: 4 CARLTON GARDENS · LONDON SW1 · TEL: TRAFALGAR 5600

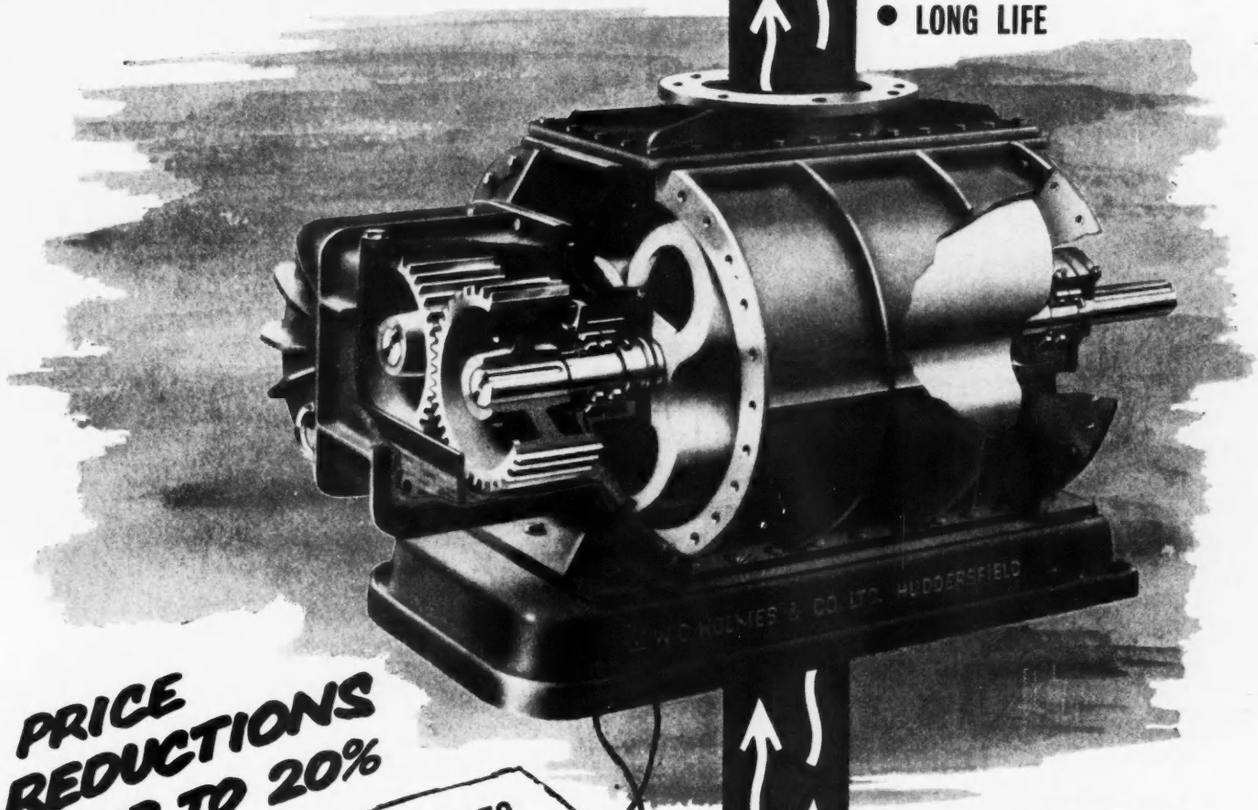
Principal P.J. Service Branches and Stock Depots:

BELFAST · BIRMINGHAM · BOOTLE · BRIGHTON · BRISTOL · GLASGOW · LEEDS MANCHESTER . NEWCASTLE-ON-TYNE · SOUTHAMPTON

Enter No. 443 on reply card

HOLMES-CONNERSVILLE POSITIVE AIR BLOWERS

- SUITABLE FOR HANDLING MOST INDUSTRIAL GASES
- NO CONTAMINATION FROM INTERNAL LUBRICATION
- CONSTANT HIGH VOLUMETRIC EFFICIENCY
- LOW OPERATING COSTS
- LONG LIFE



PRICE REDUCTIONS OF UP TO 20%

PLUS IMMEDIATE DELIVERIES

As a result of recently introduced "production line" manufacturing methods, we are able to offer the twin advantages of greatly reduced prices and immediate deliveries of Holmes-Connersville Positive Air Blowers within the following size ranges.

Capacities up to 450 c.f.m. at pressures up to 8 lb.p.s.i.
Capacities up to 700 c.f.m. at pressures up to 5 lb.p.s.i.

Larger sizes of Holmes-Connersville Positive Air Blowers can be delivered to clients' requirements.

Holmes-Connersville Positive Air Blowers have been designed to give continuous trouble free service and are consequently of extremely sturdy construction. This, combined with minimum maintenance and low running costs, makes them eminently suitable for a wide range of applications where air is required at pressures up to 10 lbs. per square inch. They are also suitable for low and medium vacuum conditions.

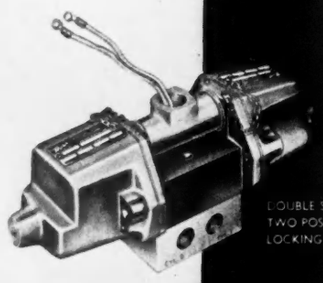
W. C. **HOLMES** & CO. LTD.

Gas Handling Division, Turnbridge, Huddersfield

Telephones: Huddersfield 5280
Birmingham: Midland 6830
London: Victoria 9971

Enter No. 451 on reply card

Ross COMET III



A NEW *PACKLESS* VALVE

FOR

PNEUMATIC & HYDRAULIC APPLICATIONS

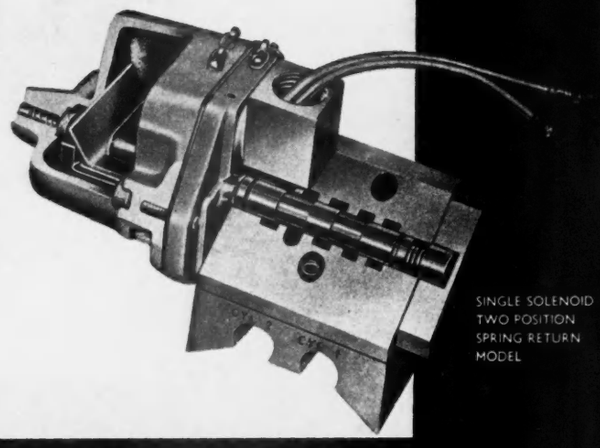
PRESSURE RANGE 0-250 P.S.I.

Direct Solenoid Operated. Lightweight. Fast Operation

Size range 1/4in. — 3/8in. B.S.P. A.C. or D.C. Supply. Dust-tight Cover

Ample Wiring Space. Captive Cover. Swivel Conduit Connection

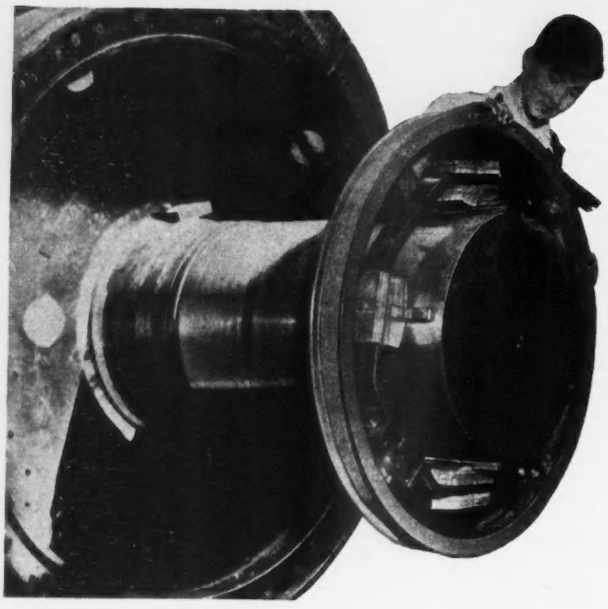
Balanced Spool. Can be Manually Operated



Please write for full details to:—

THE WELLMAN SMITH OWEN ENGINEERING CORPORATION LTD.
PARNELL HOUSE, WILTON ROAD, LONDON, S.W.1 WORKS: DARLASTON, South Staffs, & BELFAST.

Enter No. 461 on reply card



SHAFT RECONDITIONING

—without dismantling

Repairs have been carried out in a quarter of the time and at a fraction of the cost of other methods while maintaining accuracy and providing fine superfinish. With their Master Hone Portable Equipment and precision technique, Nicol & Andrew can undertake shaft reconditioning (and cylinder regrinding) in any part of the United Kingdom or Overseas.

Shafts of heavy armatures, mills, presses, colliery winders, etc., up to 48 in. in diameter have been reconditioned without dismantling by Master Hone Equipment.

AGENTS IN U.K.

BRISTOL: Walter C. Hill & Co. Ltd. Tel: Bristol 28264
COVENTRY: Elson, Margetts & Co. Ltd. Tel: Coventry 22469
NEWCASTLE: Metalock (Britain) Ltd. Tel: Newcastle 24808
CARDIFF: Hinchliffe, Lucas & Co. Ltd. Tel: Cardiff 29719
LIVERPOOL: Metalock (Britain) Ltd. Tel: Central 3820
SHEFFIELD: Metalock (Britain) Ltd. Tel: Sheffield 29361
BELFAST: J. Hamilton & Co. Ltd. Tel: Belfast 29797

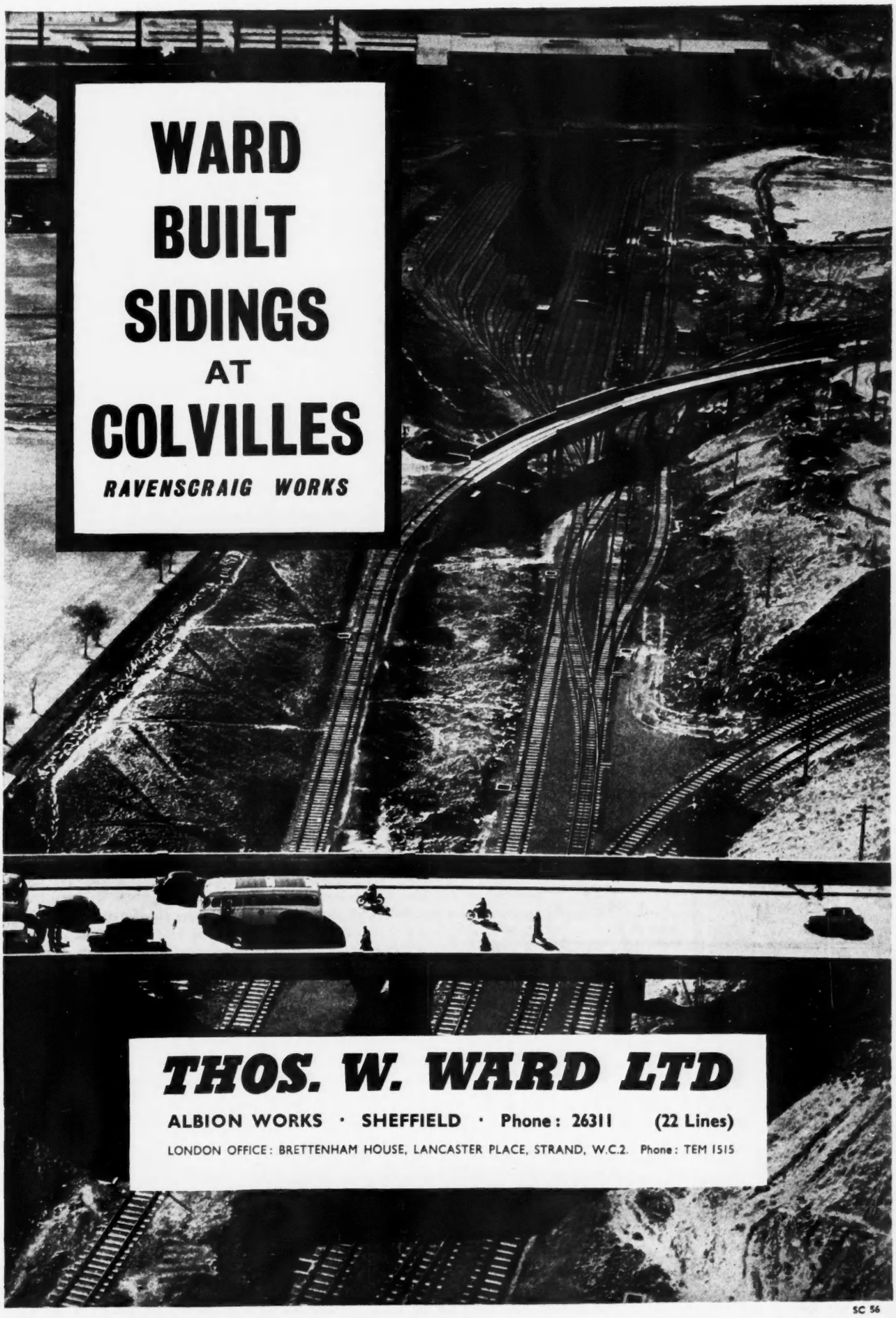
CALL IN

NICOL & ANDREW LTD.

20 Kelvin Avenue, Hillington, Glasgow, S.W.2 - - - Tel: Halfway 4724

Nicol & Andrew (London) Ltd.
188 Uxbridge Road, Hanwell, London, W.7 - - - Tel: Ealing 1088

Enter No. 462 on reply card



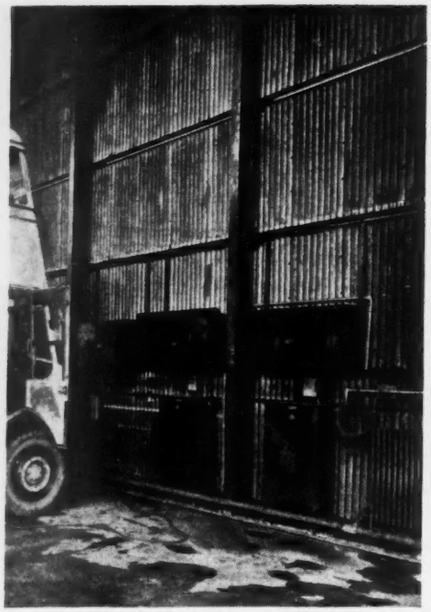
SC 56

Enter No. 471 on reply card

WESTINGHOUSE

EXPERIENCE

is your Guarantee for all Rectifier problems



1931 *Copper-oxide rectifiers charging bus batteries for Southampton Corporation.*

1958 *One of the twenty-five Westinghouse automatic universal taper chargers installed at Leith for the maintenance of batteries fitted to inter-city diesel railcars operating between Glasgow and Edinburgh.*

WESTINGHOUSE BRAKE AND SIGNAL CO., LTD., 82 York Way, King's Cross, London, N.1 *Tel: TERminus 6432*

Enter No. 481 on reply card

I'm 'Squinch', here to show
You the right place to go—
Lang Pneumatic for air information.
So drop us a line
And in double quick time
We will solve your control situation.

PNEUTOMATION

Gives a prod to production

If you think production has reached its limit in your factory—LOOK AGAIN! Better still call in Lang Pneumatic to do the detective work. Chances are, 'Pneutomation' could squeeze that extra effort out of so many of your processes.

Lang Pneumatic power systems have been the guiding hand behind a hundred-and-one widely different jobs, from jig-boring to bell-ringing, from moulding car bodies to animating a movie whale! In fact, any operation involving repetition, precise location of parts, exact amount of force applied at exactly the right time and place is a job for Pneutomation.

With Pneutomation in control, production rises and is maintained at a steady level, accuracy and quality are absolutely consistent. No human error, no rejects—and falling costs everywhere!

Lang Pneutomation needn't involve you in heavy capital investment either. Complete systems to suit practically any job are available 'off the shelf'.

So plan with Lang Pneumatic from the very beginning of every production venture—right from the start you'll be certain of the happy ending!

Write to :—

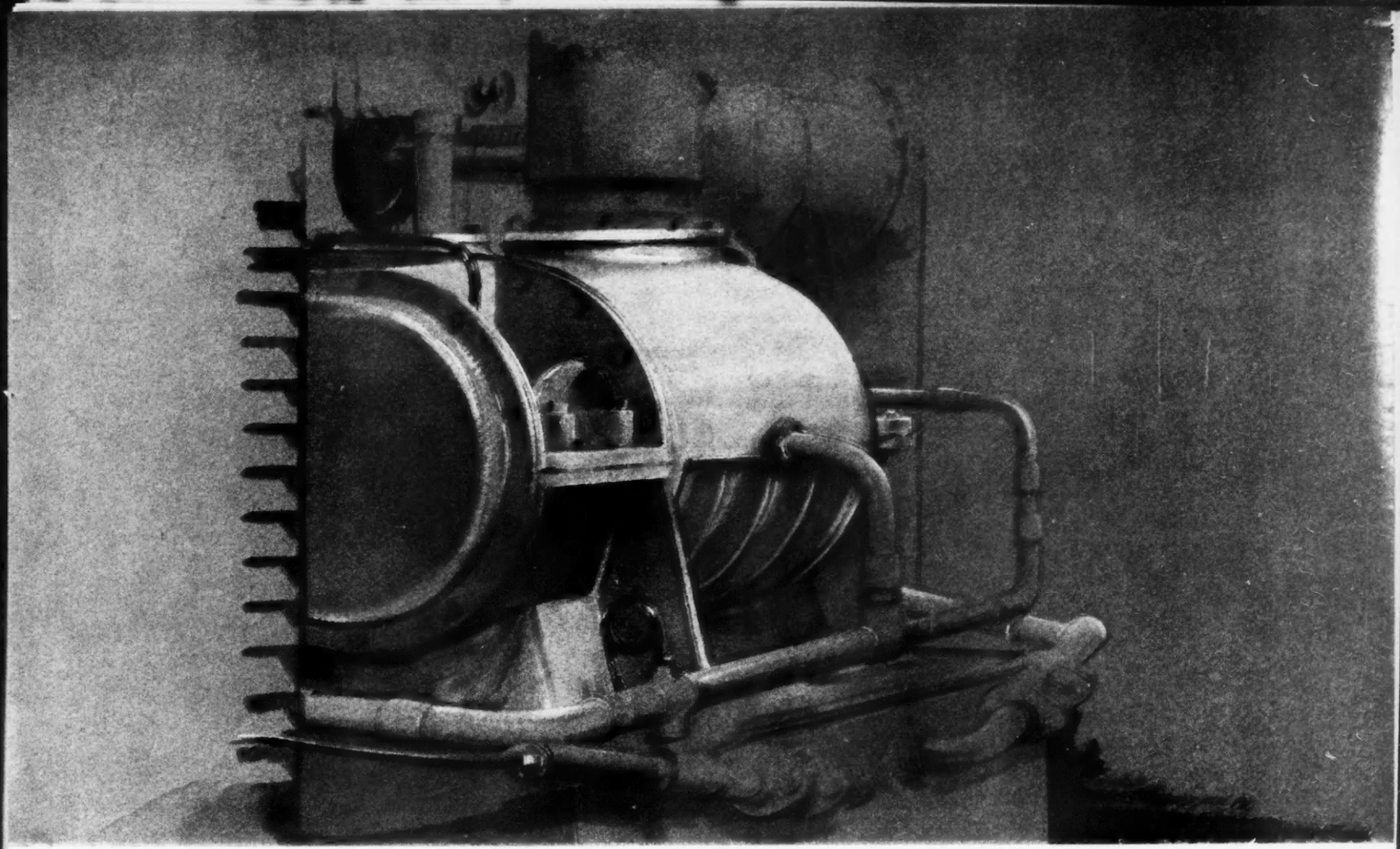
Lang Pneumatic Ltd

(ASSOCIATED WITH DESOUTTER BROTHERS (HOLDINGS) LTD.)

OWEN ROAD, WOLVERHAMPTON

Telephone Wolverhampton 25221-2-3-4

Enter No. 482 on reply card



Howden compressor at the National Gas Turbine Establishment, Farnborough: (Crown Copyright reserved)
Delivery—air at 5500 c.f.m. against 30 p.s.i.g.

Howden Compressors

ONE OF THE important features of the rotary-screw compressor, developed for many years by Howden, lies in the uniformly rotary motion which gives a positive displacement without the use of any reciprocating parts or valves.

ANOTHER FEATURE, which in combination with the first brings such outstandingly practical advantages—is the precise 'timing' of the rotors by separately encased helical gearing so that an accurately controlled running clearance is maintained between the carefully-developed rotor profiles.

THIS CLEARANCE eliminates metal-to-metal contact and mechanical wear—it also dispenses with the need for rotor lubrication. Thus, being oil-free, the rotors do not easily pick up impurities, and the delivery itself is oil-free.

Other advantages of the compressor are:—
SIMPLICITY—with easy maintenance: HIGH-EFFICIENCY; delivers clean air or any non-corrosive gas: SMOOTH FLOW; needing only small receiver: LITTLE FLOOR SPACE required; VIBRATIONLESS; needs only light foundations.

Howden compressors are driven through Howden speed-increasing gearboxes from any available power source.

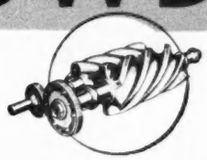
The range of Howden compressors:—
Single-stage, up to 60 p.s.i.g. discharge; from 650 c.f.m. inlet volume to 25,000 c.f.m.
Two-stage, from 60 to 150 p.s.i.g. discharge; from 2,000 c.f.m. to 25,000 c.f.m.

Howden single-stage compressors may also be used as exhausters for vacuum down to 1/5 of the prevailing atmospheric pressure: two-stage for vacuums to 1/15 of atmospheric pressure.

Howden compressors have been supplied for: Pneumatic conveyors; Work's compressed-air service; Distribution of Town's gas; As boosters for high-pressure air or gas; As exhausters for evaporating plants. In the chemical industry; compressing butane, carbon dioxide, nitrogen, propane and steam.

JAMES HOWDEN AND COMPANY LIMITED
195 SCOTLAND STREET, GLASGOW, C.5, and 15 GROSVENOR PLACE, LONDON, S.W.1

HOWDEN



Enter No. 491 on reply card

G

confidence in Brymill

One has good reason to feel confident when ordering steel from Brymill. Rod, Bar, Coiled Strip, in all sizes and specifications, are stocked by Brymill and are all scientifically tested to ensure physical properties of the correct nature for your particular need.

Brymill t·s

BRITISH ROLLING MILLS LTD.
BRYMILL STEEL WORKS · TIPTON · STAFFS

Enter No. 501 on reply card

....almost everyone thought of them first

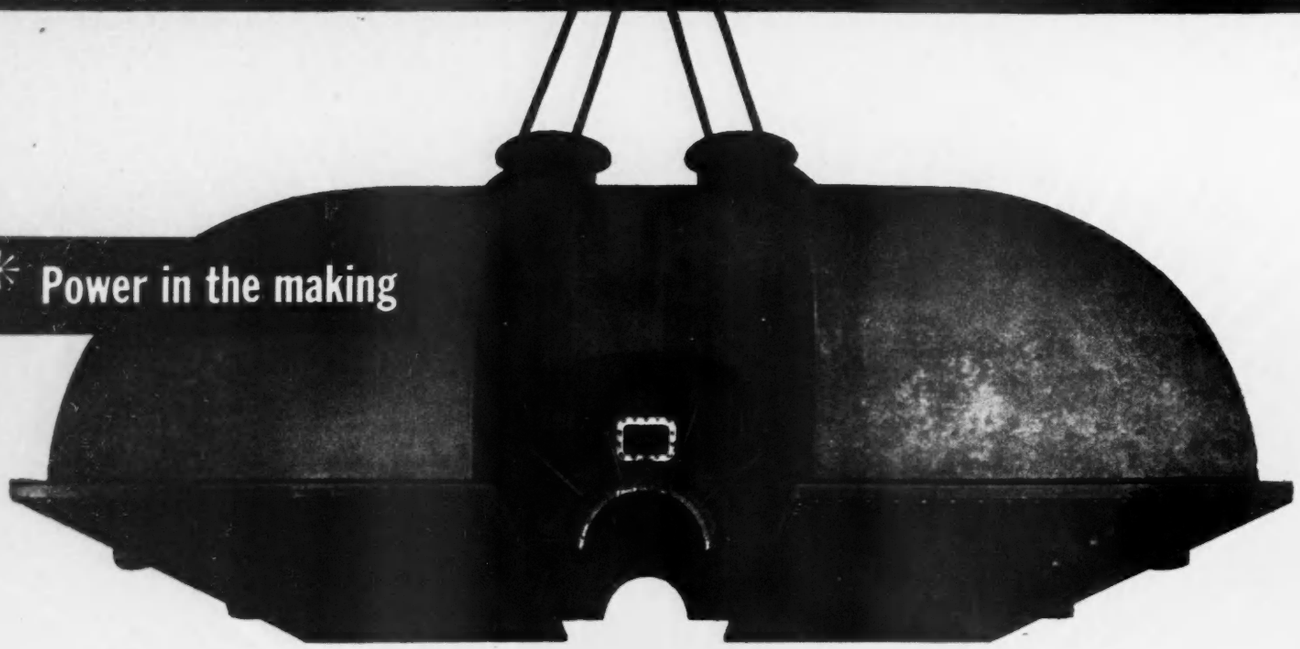
The Chinese invented everything from writing to rockets.... so they say. They may have pipped the ancient Egyptians; they certainly used them hundreds of years B.C.. The Romans knew about them and used them. As usual, the Greeks had a word for them. Even the Monks of the Middle Ages who discovered so many things may well lay claim to the invention of gears. But whoever thought of them first, lots of people make gears now. OPPERMANS OF NEWBURY FOR EXAMPLE. And as in everything else, some people make things better than others. OPPERMANS OF NEWBURY FOR EXAMPLE. Oppermans (of Newbury, you will remember) don't claim to have thought of gears first; but they think of little else now.

OPPERMANS OF NEWBURY

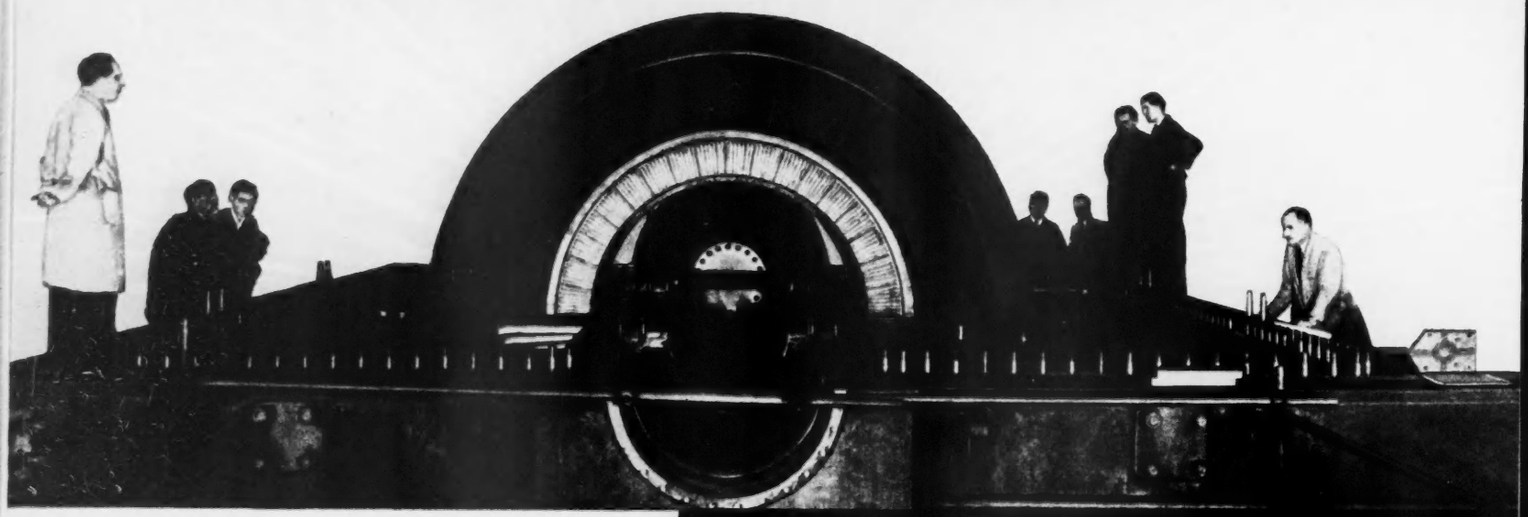
OPPERMAN GEARS LTD NEWBURY BERKSHIRE Telephone Newbury 1701 Telegrams Oppigears Newbury

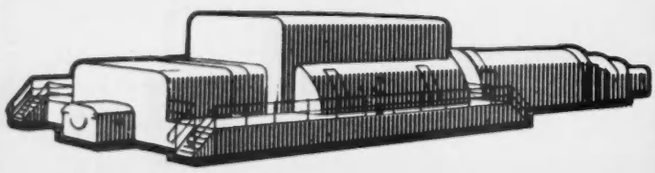
Enter No. 511 on reply card

Constructing STEAM TURBO-GENERATORS



✳ Power in the making





✳ When Sir Charles Parsons produced the first steam turbo-generator he said that the larger the plant the more economical it would be. This is realised today with the tremendous electrical output of the very large turbo-generators under construction at PARSONS Heaton Works. Some idea of the size of the large and powerful steam turbine driving units can be seen from this view of the cover for a low pressure cylinder on a PARSONS 200 MW turbo-generator. The cover is being lowered for a trial fit prior to inclusion of the bladed shaft.

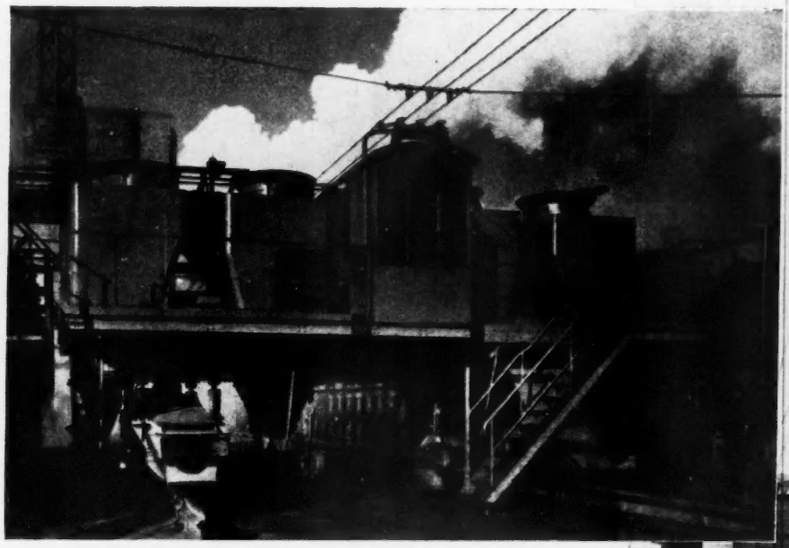
TURBO-GENERATORS · POWER TRANSFORMERS · CONDENSING PLANT

PARSONS

C. A. PARSONS & CO. LTD.

HEATON WORKS · NEWCASTLE UPON TYNE 6

Cranes and coking plant



Above: Coke Oven Loading Car at Manvers Main Coking Plant
by kind permission of the N.C.B. North Eastern Division

Right: Crane at Dover Harbour
by kind permission of the British Transport
Commission, Shipping & Continental Dept.

protected from corrosion with

EVODYNE
CHLORINATED RUBBER PAINTS

OVER

EVOLED
THE PATENTED RED LEAD PRIMER

the perfect combination for corrosion protection under highly acidic and marine conditions

A PRODUCT OF EVODE OF STAFFORD

Manufacturers of BITUGEL, EVOKOTE and EVOTECT paints

✳ **SEND FOR LITERATURE** EVODE LTD., (PAINTS DIVISION) STAFFORD. Telephone: 2241-5

London Office: 82 VICTORIA STREET, S.W.1. Telephone: ABBey 4622-3

H-W.1098

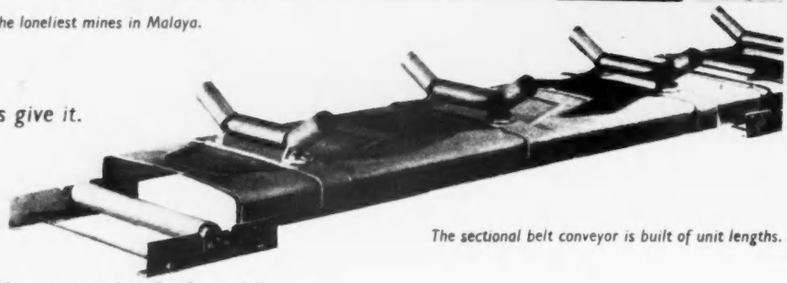
Enter No. 531 on reply card
H

Sports Times picture

FOR TOUGH WORK OUT BACK—M&C CONVEYORS

Feeding tin ore to an M&C belt at one of the loneliest mines in Malaya.

So remote a site demands reliability. M&C belt conveyors give it. They also give low upkeep cost. The idlers can spin at a touch, and they keep that way, for they resist both dust and deluge. Proof abounds that they are sealed for **long** *life.*



The sectional belt conveyor is built of unit lengths.

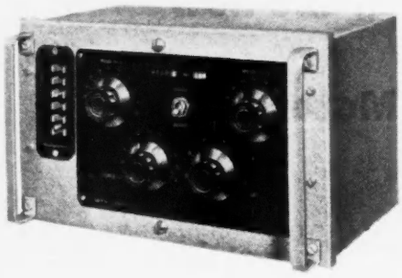
MAVOR & COULSON LTD *Bridgeton Glasgow S.E. · Olive Grove Rd Sheffield 2 · 36 Victoria St London S.W.1*

Enter No. 541 on reply card

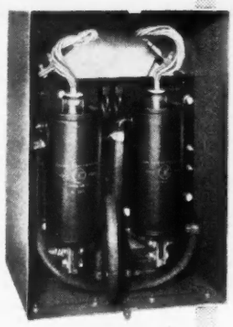
British Federal

.....now have capacity available for design and manufacture of electronic equipment for general industrial applications.

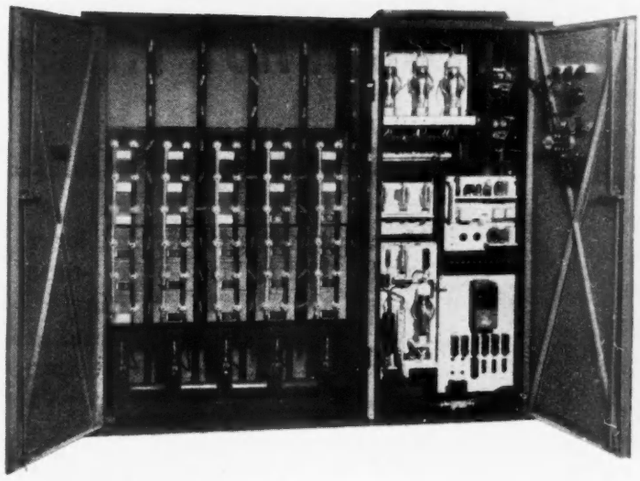
electronics



British Federal type WFO/1 sequence timer for control of portable welding equipment having two guns and with individual timing controls for each gun. Fully interlocked sequence is provided for both units.



British Federal ignitron contactor unit fitted with "C" size tubes, available as combined unit, with electronic timer.



Special electronic condenser discharge control for industrial processing.

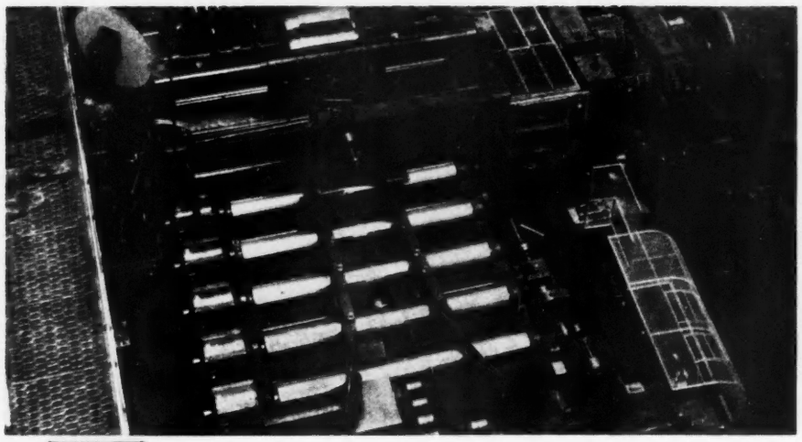
BRITISH FEDERAL WELDER & MACHINE CO. LTD.
CASTLE MILL WORKS · DUDLEY · WORCS.
TELEPHONE DUDLEY 3114

industrial control

Enter No. 551 on reply card

ARMOURCHROME

The PROVEN process for Hard Chromium Deposition

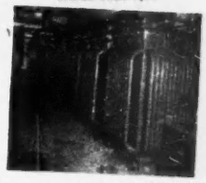


Armourchromed Rolls, over 11ft long, in use at Banbury.
Photograph by courtesy of The Northern Aluminium Co. Ltd.

ARMOURCHROME will increase the working life of Rolls, Die-Sets and Press Tools several times. Be sure your NEW equipment is pre-treated with this cost-cutting, ultra-durable process and remember that worn, rejected components can be reclaimed by the application of ARMOURCHROME. Approved by A.I.D. Test House and the various Ministries, ARMOURCHROME provides a VDH rating of approximately 900, helps to eliminate scoring, roll marks and other blemishes from the finished job besides giving protection from deterioration in storage. Ask our Technical Sales Department for further details NOW !

Scientific Control

Skilled Technique



The Power behind ARMOURCHROME

Precision Inspection

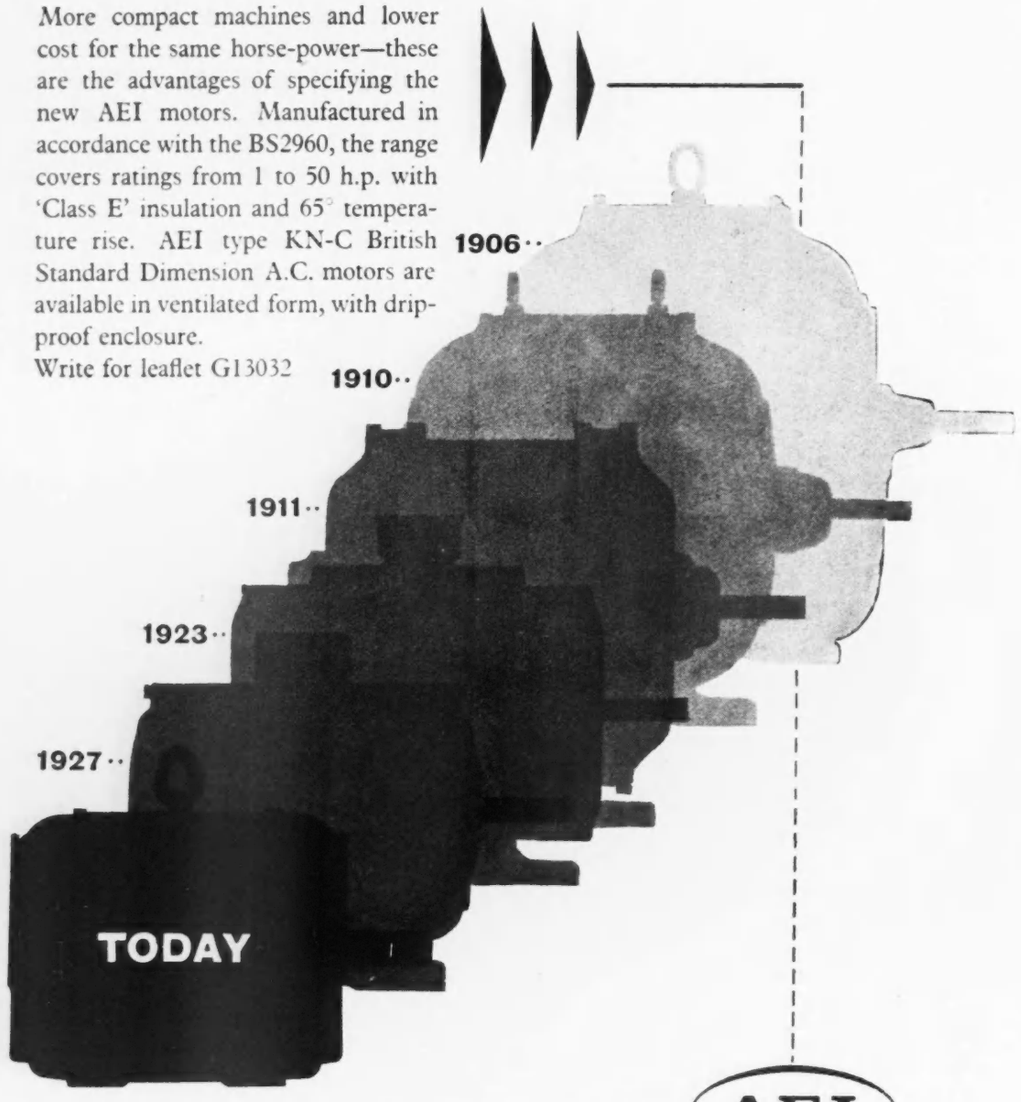
THE BRIGHTSIDE PLATING COMPANY LTD.,
Brearley Street · Birmingham 19 · *Tel: Aston Cross 2663*

Enter No. 552 on reply card

COMPACT HORSEPOWER with the new

AEI British Standard Dimension Motors

More compact machines and lower cost for the same horse-power—these are the advantages of specifying the new AEI motors. Manufactured in accordance with the BS2960, the range covers ratings from 1 to 50 h.p. with 'Class E' insulation and 65° temperature rise. AEI type KN-C British Standard Dimension A.C. motors are available in ventilated form, with drip-proof enclosure.
Write for leaflet G13032



AEI

ASSOCIATED ELECTRICAL INDUSTRIES LIMITED

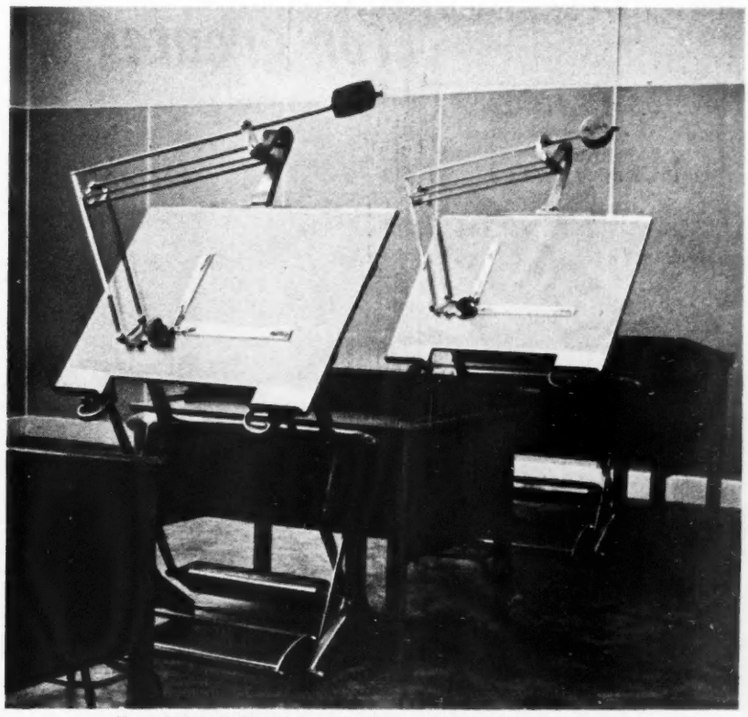
MOTOR & CONTROL GEAR DIVISION RUGBY & MANCHESTER, ENGLAND

INCORPORATING THE MOTOR & CONTROL GEAR INTERESTS OF BTH & M-V

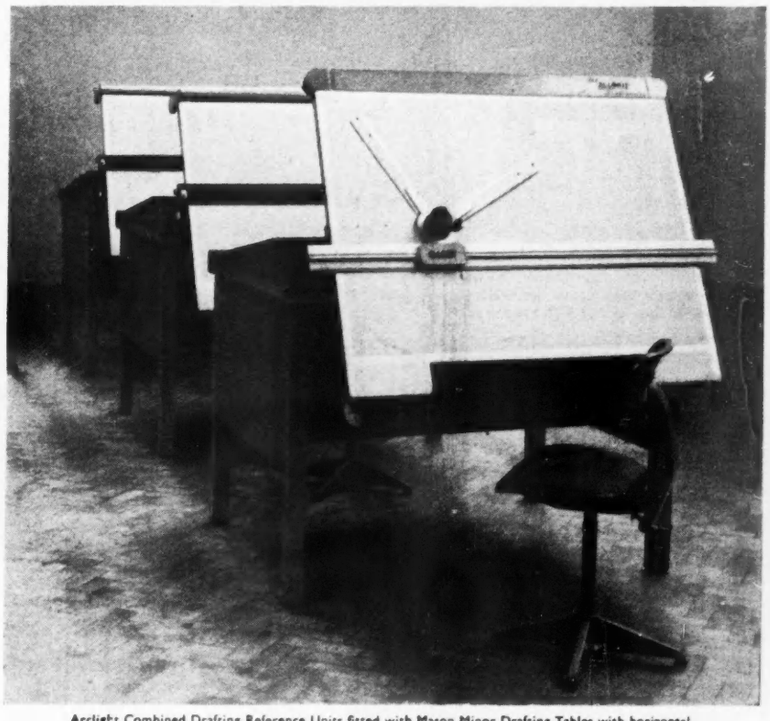
A5439

Enter No. 561 on reply card

FOR DRAWING OFFICE EQUIPMENT FOR EVERY DRAFTING REQUIREMENT CONSULT THE MANUFACTURERS WITH 55 YEARS OF DRAWING OFFICE EXPERIENCE BEHIND THEM



Mason Drafting Tables with vertical drafting machines used in conjunction with Arclight sliding top reference units arranged for "back reference"



Arclight Combined Drafting Reference Units fitted with Mason Minor Drafting Tables with horizontal "Draftmaster" drafting machines. These units also are arranged for "back reference"

E. N. MASON & SONS LTD.

ARCLIGHT WORKS, COLCHESTER	Telephone: Colchester 5191
SENTINEL HOUSE, SOUTHAMPTON ROW, LONDON, W.C.1.	Telephone: Clerkenwell 4064
28-31 DALLINGTON STREET, LONDON, E.C.1.	Telephone: Clerkenwell 4064
13-15 ST. VINCENT PLACE, GLASGOW, C.1.	Telephone: Central 3775
8-10 NEWTON STREET, MANCHESTER, 1.	Telephone: Deansgate 3942
BROUGHTON WORKS, BLACKBURN STREET, SALFORD, 3.	Telephone: Deansgate 3942
ALBERT ROAD, STECHFORD, BIRMINGHAM, 33.	Telephone: Stechford 4442
14 COOK STREET, LIVERPOOL, 2.	Telephone: Central 6514
51 VICTORIA STREET, SHEFFIELD, 1.	Telephone: Sheffield 21776
6 BRITANNIA HOUSE, WELLINGTON STREET, LEEDS, 1.	Telephone: Leeds 23537
3 UNITY STREET, BRISTOL, 1.	Telephone: Bristol 92441

Enter No. 571 on reply card

WELDED STEEL PLATEWORK
In ¼" to ½" thick Mild Steel

PRESSURE VESSELS
TANKS & CYLINDERS
CHIMNEYS
DRYERS
HOPPERS
CYCLONES
BEDPLATES
ANGLE & FLAT BAR RINGS

C&M. ENGINEERING CO. LTD.

THAMES Rd. BARKING, ESSEX
TELEPHONE: RIPpleway 3011-2

Enter No. 581 on reply card

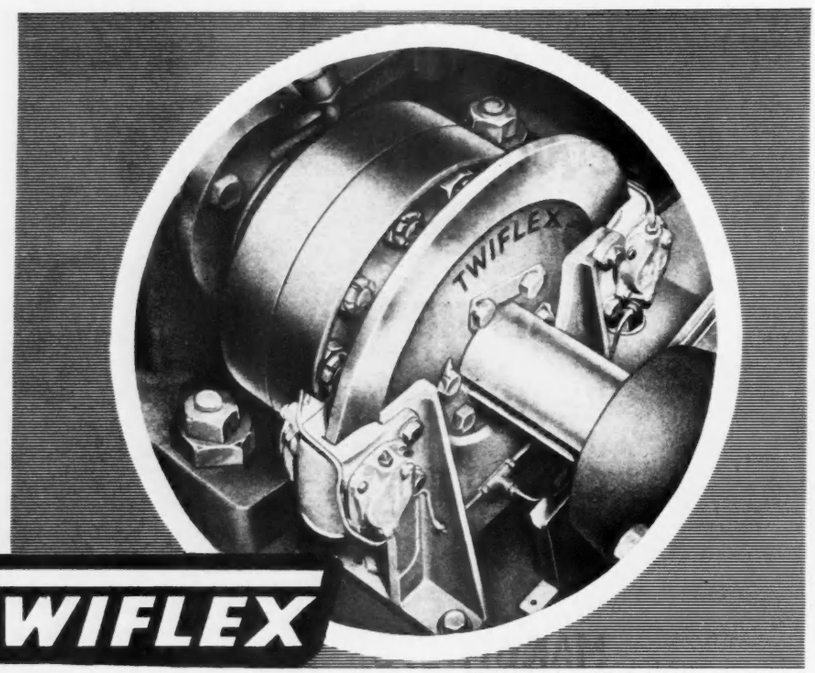
TRADE Smedley MARK
PAN GRINDING MILLS

REVOLVING OR STATIONARY PANS
PERFORATED OR SOLID BOTTOMS
OVER OR UNDER DRIVEN

Smedley Brothers, Ltd.
Belper. Derbyshire.
Telephone: Belper 12

Enter No. 582 on reply card

for greater **STOPPING** *power . . .*



TWIFLEX

Heavy duty industrial disc brake with double calliper unit

industrial DISC brakes!

The development of the disc braking system has been one of the most dramatic events in motoring history.

This revolutionary system is now available for industry and Twiflex Industrial Disc Brakes are setting new standards — wherever effective control means the greatest use of available power resources.

Effective control? A typical Twiflex Disc Brake installation is capable of absorbing 90,000 ft. lb. of energy in ·2 seconds!

Twiflex Industrial Disc Brakes are superior to existing braking methods *in every way* because they give you . . .

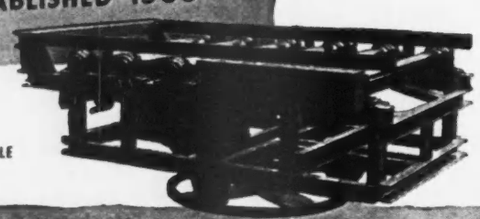
- **Maximum efficiency under all conditions.**
- **Immediate pad clearance on release**
- **Complete absence of "brake fade"**
- **Automatic adjustment for wear**
- **Long life, reliability and ease of maintenance**

For full information write to:

TWIFLEX COUPLINGS LIMITED (*One of the Sheepbridge Engineering Group*)
The Green · Twickenham · Middlesex. Telephone: POPesgrove 2206/9. Telegrams: Twiflex · Twickenham

Enter No. 583 on reply card

ROBSON CONVEYORS
ESTABLISHED 1906



10 TON
ROLLER TURNTABLE

Geo. ROBSON & CO. (CONVEYORS) LTD.
HODGSON STREET · SHEFFIELD.
PHONE. SHEFFIELD. 27463/4

Enter No. 584 on reply card

THE WORLD'S GREATEST BOOKSHOP

FOYLES
FOR BOOKS

FAMED CENTRE FOR
Technical Books

"That's what I call quick service—I telephoned Foyles at 10 a.m. and the book (although it was out-of-print) reached me by the next morning's post." —*A Customer's Letter*

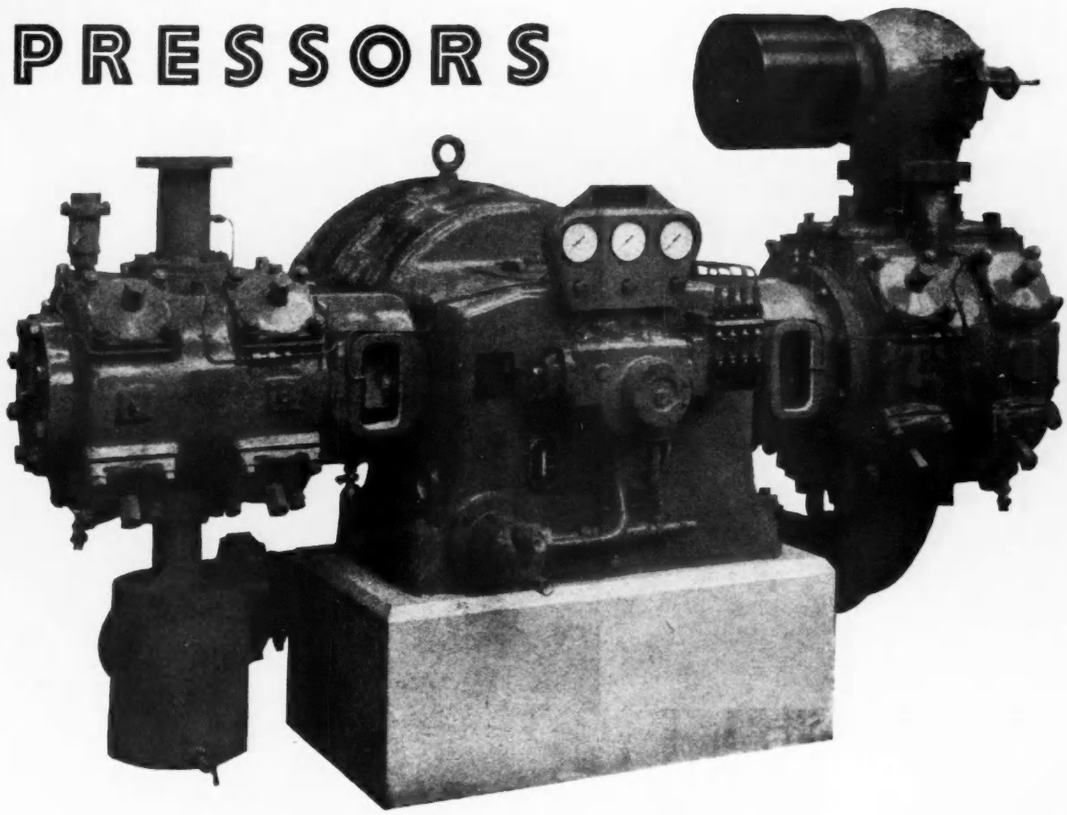
FOYLES TRAVEL BUREAU.
Road, Rail, Sea, Air tickets

119-125 CHARING CROSS ROAD, LONDON, W.C.2
Gerrard 5660 (20 lines) ★ Open 9—6 (including Saturdays)
Two minutes from Tottenham Court Road Station

Enter No. 585 on reply card

ALLEY

BALANCED OPPOSED COMPRESSORS



The long established high quality of Alley Compressors is combined in these machines with the known advantages of the horizontally-opposed design.

COMPACTNESS: Intercooler lies below motor. Motor is built on.

BALANCE: No horizontal or vertical out-of-balance forces.

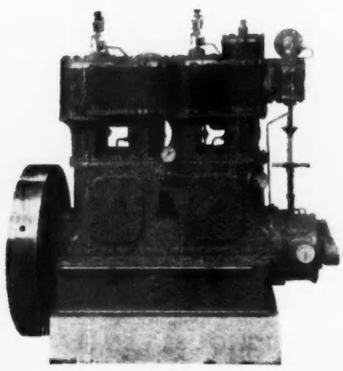
FREEDOM FROM VIBRATION

Can be installed on a minimum foundation—even on an upper floor.

The unit is complete—intercooler and oilcooler incorporated—ready for bolting down.

Range of single and two stage machines up to 10,000 c.f.m.

A corresponding range of VACUUM PUMPS is available with displacements up to 12,000 c.f.m.



ALLEY & MACLELLAN (POLMADIE) LTD.,
GLASGOW, S.2.

THE ALLEY B/L STEAM ENGINE: A high class range of single and two cylinder engines of compound and non-compound type, with outputs ranging from 40 B.H.P. to 750 B.H.P.

Enter No. 591 on reply card

WELDED STEEL PLATEWORK
In ¼" to 4" thick Mild Steel

PRESSURE VESSELS
TANKS & CYLINDERS
CHIMNEYS
DRYERS
HOPPERS
CYCLONES
BEDPLATES
ANGLE & FLAT BAR RINGS

C&M ENGINEERING CO. LTD

THAMES Rd. BARKING, ESSEX
TELEPHONE: RIPpleway 3011-2

Enter No. 581 on reply card

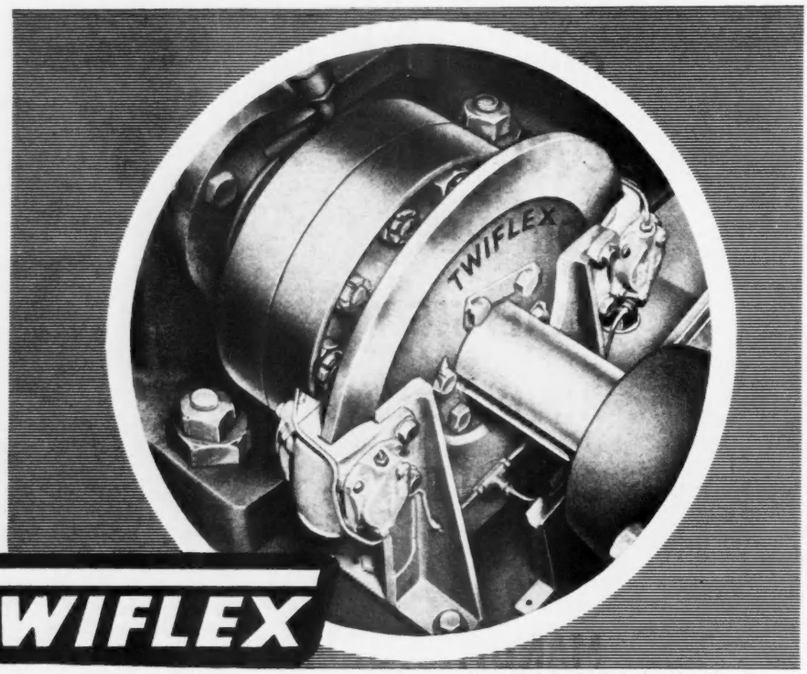
TRADE Smedley MARK
PAN GRINDING MILLS

REVOLVING OR STATIONARY PANS
PERFORATED OR SOLID BOTTOMS
OVER OR UNDER DRIVEN

Smedley Brothers, Ltd.
Belper, Derbyshire.
Telephone: Belper 12

Enter No. 582 on reply card

for greater STOPPING power . . .



TWIFLEX

Heavy duty industrial disc brake with double calliper unit

industrial DISC brakes!

The development of the disc braking system has been one of the most dramatic events in motoring history.

This revolutionary system is now available for industry and Twiflex Industrial Disc Brakes are setting new standards — wherever effective control means the greatest use of available power resources.

Effective control? A typical Twiflex Disc Brake installation is capable of absorbing 90,000 ft. lb. of energy in ·2 seconds!

Twiflex Industrial Disc Brakes are superior to existing braking methods *in every way* because they give you . . .

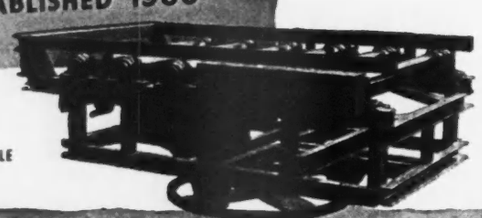
- Maximum efficiency under all conditions.
- Complete absence of "brake fade"
- Immediate pad clearance on release
- Automatic adjustment for wear
- Long life, reliability and ease of maintenance

For full information write to:

TWIFLEX COUPLINGS LIMITED (*One of the Sheepbridge Engineering Group*)
The Green · Twickenham · Middlesex. Telephone: POPesgrove 2206/9. Telegrams: Twiflex · Twickenham

Enter No. 583 on reply card

ROBSON CONVEYORS
ESTABLISHED 1906



10 TON
ROLLER TURNTABLE

Geo. ROBSON & CO. (CONVEYORS) LTD.
HODGSON STREET · SHEFFIELD.
PHONE. SHEFFIELD. 27463/4

Enter No. 584 on reply card

THE WORLD'S GREATEST BOOKSHOP

FOYLES
++ FOR BOOKS ++

FAMED CENTRE FOR
Technical Books

"That's what I call quick service—I telephoned Foyles at 10 a.m. and the book (although it was out-of-print) reached me by the next morning's post." —*A Customer's Letter*

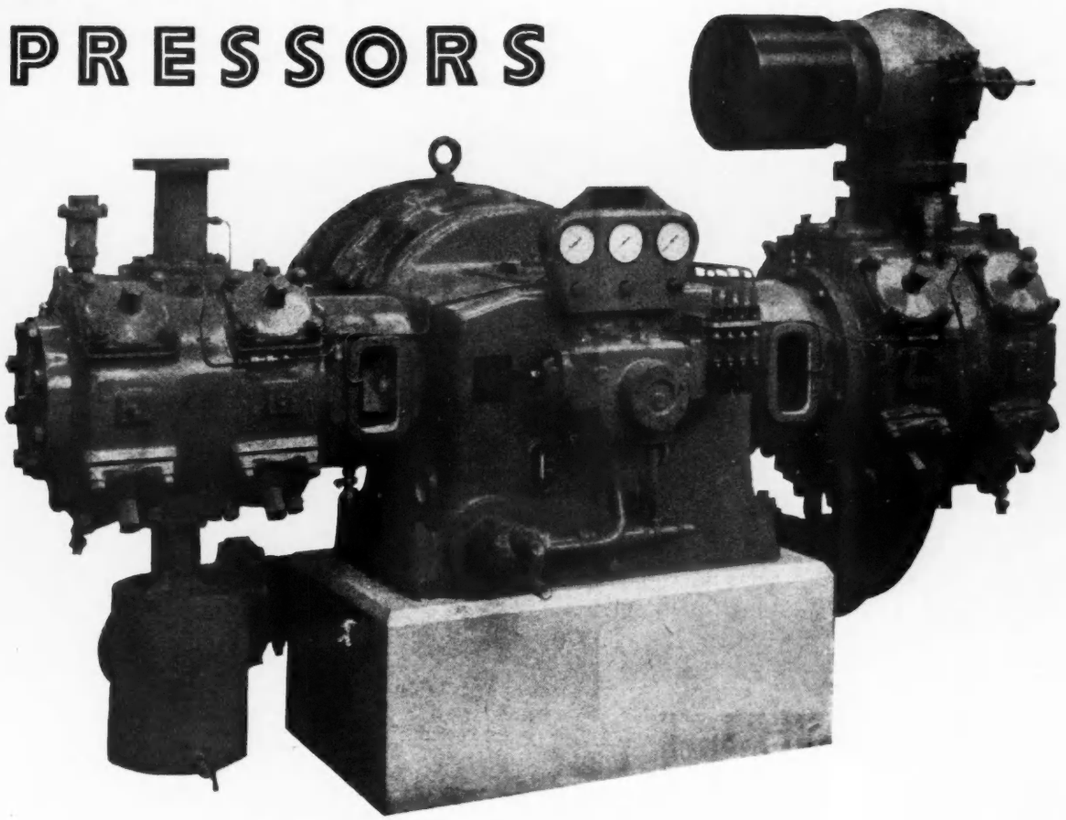
FOYLES TRAVEL BUREAU.
Road, Rail, Sea, Air tickets

119-125 CHARING CROSS ROAD, LONDON, W.C.2
Gerrard 5660 (20 lines) ★ Open 9—6 (including Saturdays)
Two minutes from Tottenham Court Road Station

Enter No. 585 on reply card

ALLEY

BALANCED OPPOSED COMPRESSORS



The long established high quality of Alley Compressors is combined in these machines with the known advantages of the horizontally-opposed design.

COMPACTNESS: Intercooler lies below motor. Motor is built on.

BALANCE: No horizontal or vertical out-of-balance forces.

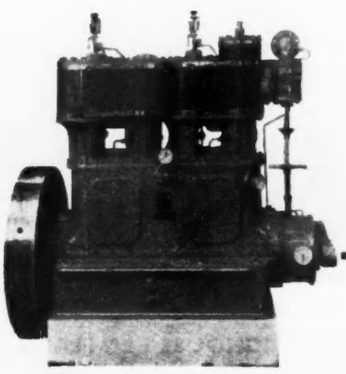
FREEDOM FROM VIBRATION

Can be installed on a minimum foundation—even on an upper floor.

The unit is complete—intercooler and oilcooler incorporated—ready for bolting down.

Range of single and two stage machines up to 10,000 c.f.m.

A corresponding range of VACUUM PUMPS is available with displacements up to 12,000 c.f.m.

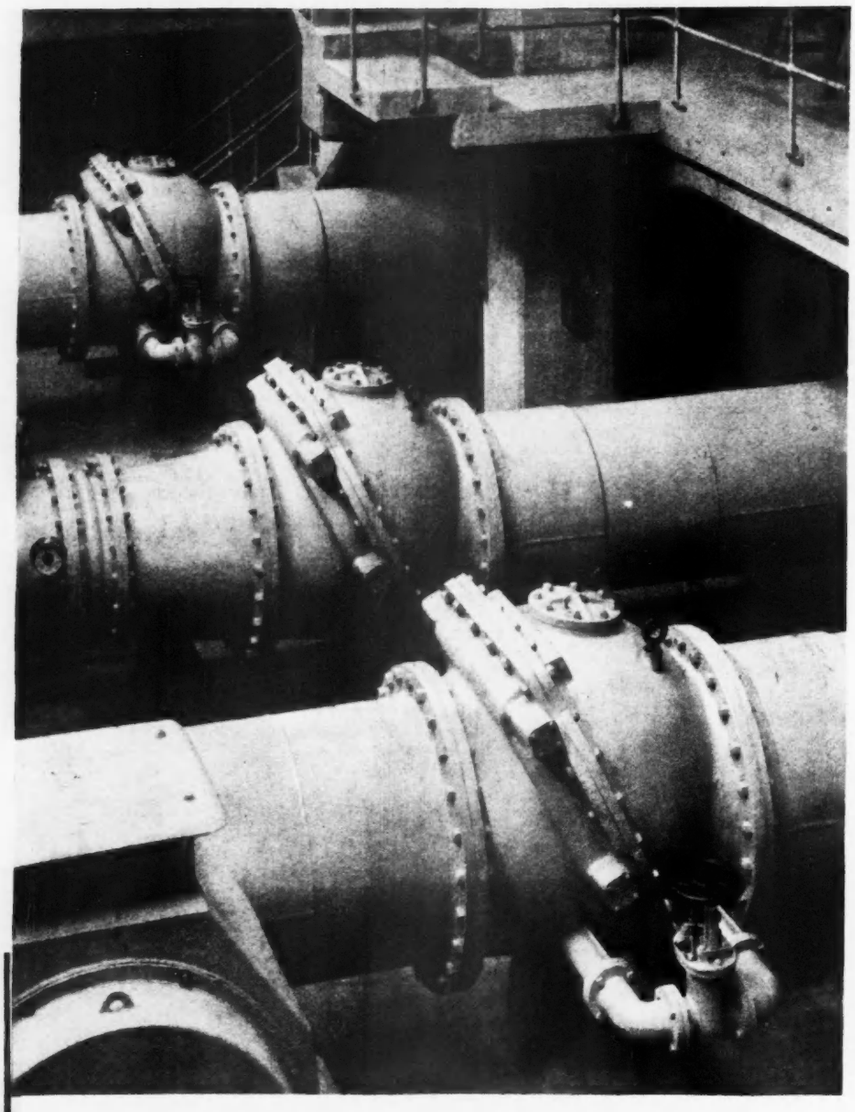


ALLEY & MACLELLAN (POLMADIE) LTD.,
GLASGOW, S.2.

THE ALLEY B/L STEAM ENGINE: A high class range of single and two cylinder engines of compound and non-compound type, with outputs ranging from 40 B.H.P. to 750 B.H.P.

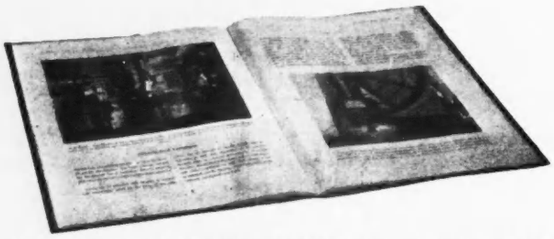
Enter No. 591 on reply card

Pump Non-Return Valves



The Blakeborough Free-acting Type Reflux Valve has been designed expressly for conditions on the discharge side of modern centrifugal pumps, and has become one of the most extensively used types where requirements are at all exacting. It is produced in single and multiple door patterns, covering sizes from 6 in. to 72 in. bore. Full details in list 203 available on request.

- ★ Quick closing action, for slam-free seating under rapid flow decelerations.
- ★ Maximum durability in service, with negligible hinge friction and wear.
- ★ Clean, well-designed waterway and properly directed flow, for low hydraulic resistance.
- ★ Outstanding simplicity of construction.



BLAKEBOROUGH

J. BLAKEBOROUGH & SONS LTD · BRIGHOUSE · ENGLAND

Enter No. 601 on reply card

AEI

Make sure your **PLANING MACHINES** *include the latest electrical equipment, developed specially by* **A.E.I.** *to give increased production. Equipments have been supplied and proved by the leading British Planer Manufacturers.*

Ten good reasons for increased production

- Increased horsepower available at the tool for high speed machining
- Wide range of table speeds is obtained for all classes of machining ; the total range being approximately 50/1.
- Maximum speed and optimum performance held irrespective of load
- High duty cycle by rapid reversal of the table
- Controlled torque during reversal gives shockless drive to main transmission with smooth acceleration and deceleration
- Simplified circuits reduce maintenance
- All controls can be arranged adjacent to the operator; this reduces setting up time and operator's fatigue.

  Infinitely variable feeds ensure optimum machining conditions
- Two rates of traverse of the tool box provide rapid movement and close setting of the tool
- Combines a new system of control to the planer table with a modernised arrangement of planer feed control for the tool boxes

A closed loop system, incorporating a magnetic amplifier of the flux resetting type, controls the variable voltage main reversing motor.
The angular rotation of the feed motor is selected by means of a magnetic integrator circuit.

ASSOCIATED ELECTRICAL INDUSTRIES LIMITED

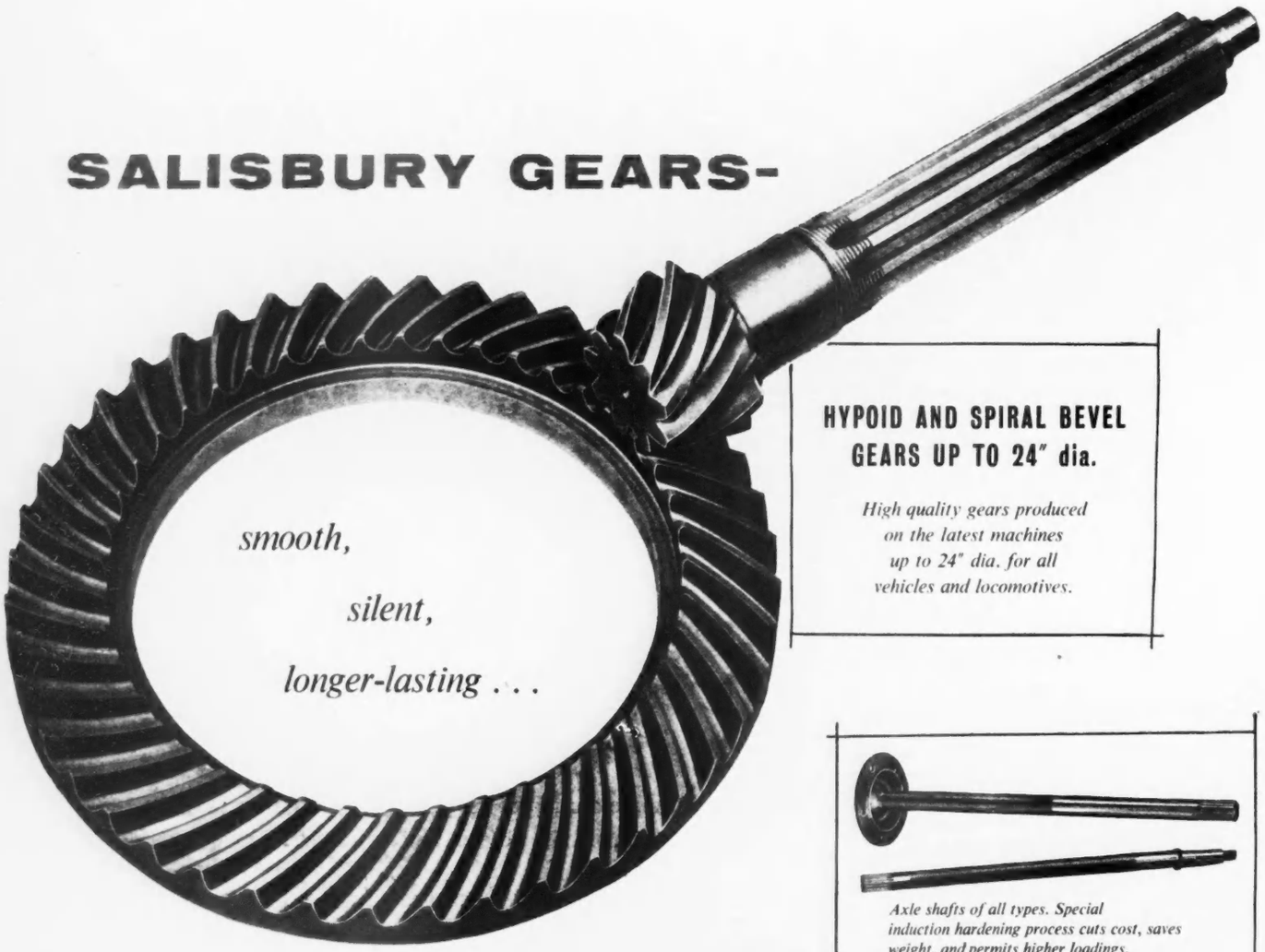
MOTOR & CONTROL GEAR DIVISION — **RUGBY & MANCHESTER, ENGLAND**

B T·H **INCORPORATING THE MOTOR & CONTROL GEAR INTERESTS OF BTH & M-V** M V

J/T901

Enter No. 611 on reply card

SALISBURY GEARS-



HYPOID AND SPIRAL BEVEL GEARS UP TO 24" dia.

High quality gears produced on the latest machines up to 24" dia. for all vehicles and locomotives.

Axle shafts of all types. Special induction hardening process cuts cost, saves weight, and permits higher loadings.

SALISBURY gears are smooth, silent and longer-lasting because of their exceptionally good finish – the result of the most recent manufacturing techniques and of constant attention to detail.

THERE ARE OTHER BENEFITS of this careful quantity-production on the most modern machines . . . excellent quality in every way . . . less servicing . . . a really competitive price . . . and, most important, *delivery on time*. That's why Salisbury gears are increasingly specified by designers and manufacturers . . . for cars such as Jaguar and Aston Martin, for the new diesel locomotives, for the tough work of building and agricultural machinery.

Revacycle and Coniflex low-cost gears, for car and light commercial differentials up to 4¼" pitch cone distance.

SALISBURY TRANSMISSION LTD.

shares in the joint technical, research and productive resources of more than 20 famous firms, such as Laycock Engineering Ltd., Forgings and Presswork Ltd., Hardy Spicer Ltd., The Phosphor Bronze Co. Ltd., and others, who constitute the Birfield Group of Companies.

SALISBURY make most kinds of gears, axle shafts and transmissions for industry and commerce. And Salisbury technicians are always glad to co-operate on new projects and problems. Perhaps they can help you too? Please write for further details.

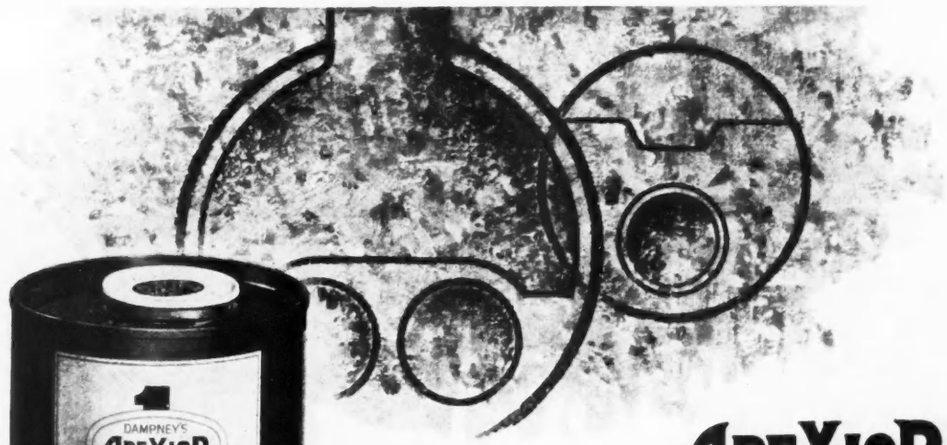
SALISBURY TRANSMISSION LTD

BIRCH ROAD · WITTON · BIRMINGHAM 6

Member of the **Birfield Group**

Enter No. 621 on reply card

Between you and Boiler Corrosion . . .



DAMPNEY'S
APEXIOR
REGISTERED
COMPOUND
A PROTECTIVE COATING FOR THE INTERIOR SURFACES OF ALL TYPES OF STEAM PLANT INCLUDING BOILERS, ECONOMISERS, CALORIFIERS AND STEAM TURBINES ALSO FOR HOT WATER TANKS ABOVE 170°F
MANUFACTURED ONLY BY
BRITISH PAINTS LIMITED
ENGLAND

An impenetrable shield of APEXIOR REGISTERED No. 1

On guard, and constantly ready to fight against corrosion in boilers or steam raising plant is Apexior No. 1.

Applied as a thin film to surfaces which encounter water or steam temperatures between 170°—1000°F., Apexior No. 1 is an effective, low cost protection for expensive boiler plant. It cuts corrosion to an absolute minimum; reduces scale formation. Any scale which forms can be easily and speedily removed without danger of damage to plant as it is non-adherent.

Other advantages come with Apexior No. 1: heat transmission is improved; and since Apexior is an inert coating, feed water is left completely free from discolouration or contamination. Keep step with industry to-day be boiler wise and Apexiorise.

For full information on all aspects of Apexior No. 1 write for Booklet "Preventing Boiler Corrosion".

BPL/A46

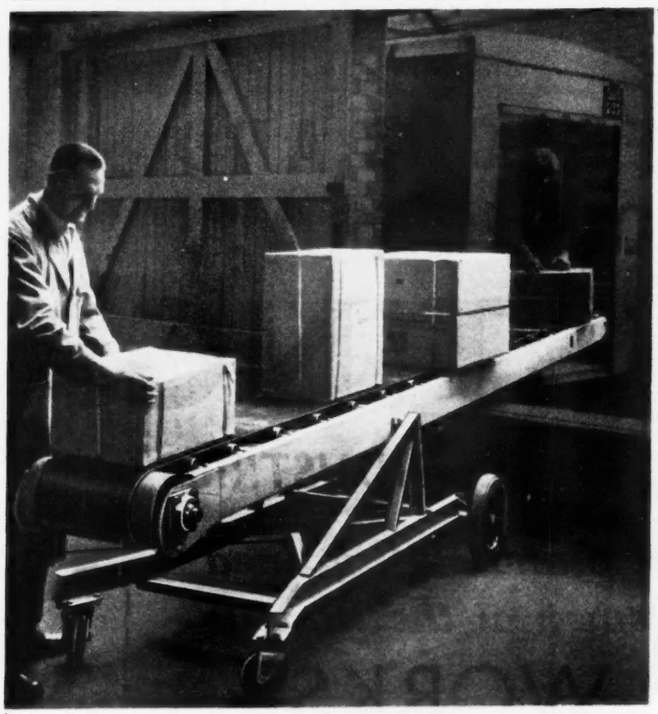
BRITISH PAINTS LIMITED Apexior Division

Portland Road, Newcastle upon Tyne 2

London · Liverpool · Sydney · Adelaide · Durban · Cape Town · Calcutta · Trinidad · New York · Dublin

OUR WORLD-WIDE SERVICE IS AT YOUR DISPOSAL FOR THE ASKING

Enter No. 631 on reply card



Boxing Clever !

The very well known firm of plastics manufacturers, Cascelloid Ltd., use this Loading Conveyor to accelerate the despatch of cartoned goods.

The Conveyor is of a particularly light and portable type having solid rubber cushion tyred wheels at one end and castors at the other, while the boom is hinged approximately at the point of balance allowing a very easy and wide variation in both feed and discharge heights.

The Loader is fitted with rough top belting and the drive provided by means of a Thorite Motorised Driving Drum; pressed steel channel side frames give a clean and modern appearance.

T. & T. WORKS LTD.

BILLESDON, LEICESTER

Tel: Billesdon 261. Grams: 'Conveyor' Leicester
London Office: 39, Windsor House, 46, Victoria Street, London, S.W.1. Tel: ABBey 6085

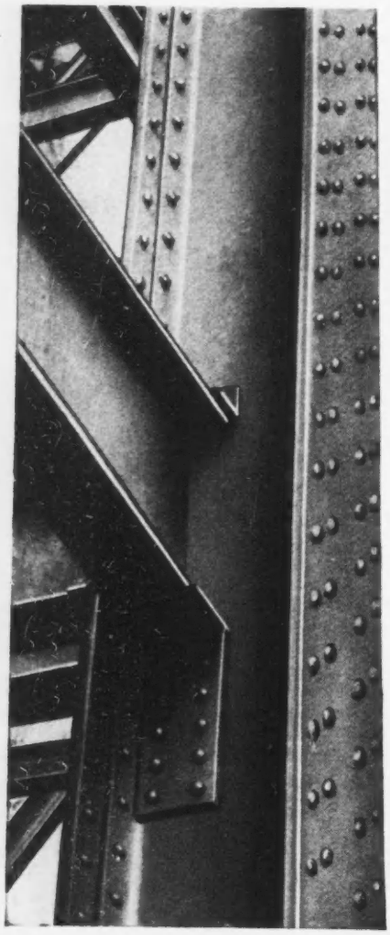
T & T
CONVEYORS RELEASE MANPOWER

On special installations, T. & T. offer a lifetime's experience and personal director service.

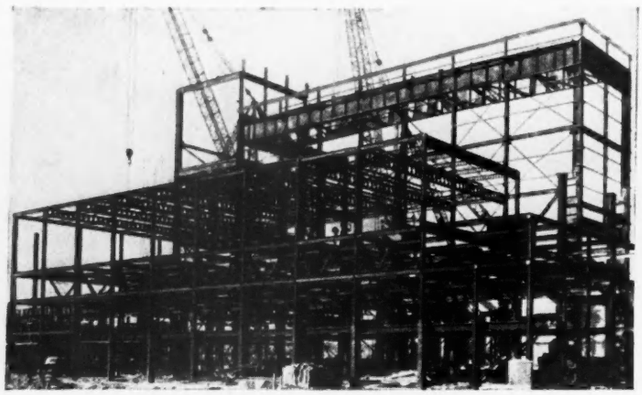
On standard installations, T. & T. give you very early delivery—often from stock—and free trials can be arranged.

Please write for fully illustrated literature.

Enter No. 632 on reply card



STRUCTURAL STEELWORK



. . . of all kinds, Steel Bridges, piers and jetties, power stations and industrial works, factories, flats and offices, warehouses and storage depots, cinemas, radio masts and marine steelwork—all over the world. A jetty at Penang and the Gaumont cinema at Chelsea, the British Industries Pavilion at Brussels and a block of flats on the Bayswater Road—they are all just a part of the story of the contribution to progress made by one of Britain's most modern engineering organisations . . . .

HORSELEY GROUP — The HORSELEY Group

HORSELEY BRIDGE & THOMAS PIGGOTT LTD.,
Tipton Staffs.
CARTER HORSELEY (ENGINEERS) LTD.,
Tipton, Waddon, Sheffield, Newcastle, and Liverpool.
MECHANS LTD.,
Glasgow W.4

Enter No. 641 on reply card

G K

GUEST KEEN IRON & STEEL COMPANY

For... FERROUS AND NON-FERROUS

CASTINGS

FOR ALL INDUSTRIES

Made with the experience and skill gained by generations of craftsmen at the famous

DOWLAIS WORKS

Telephone: Dowlais 70

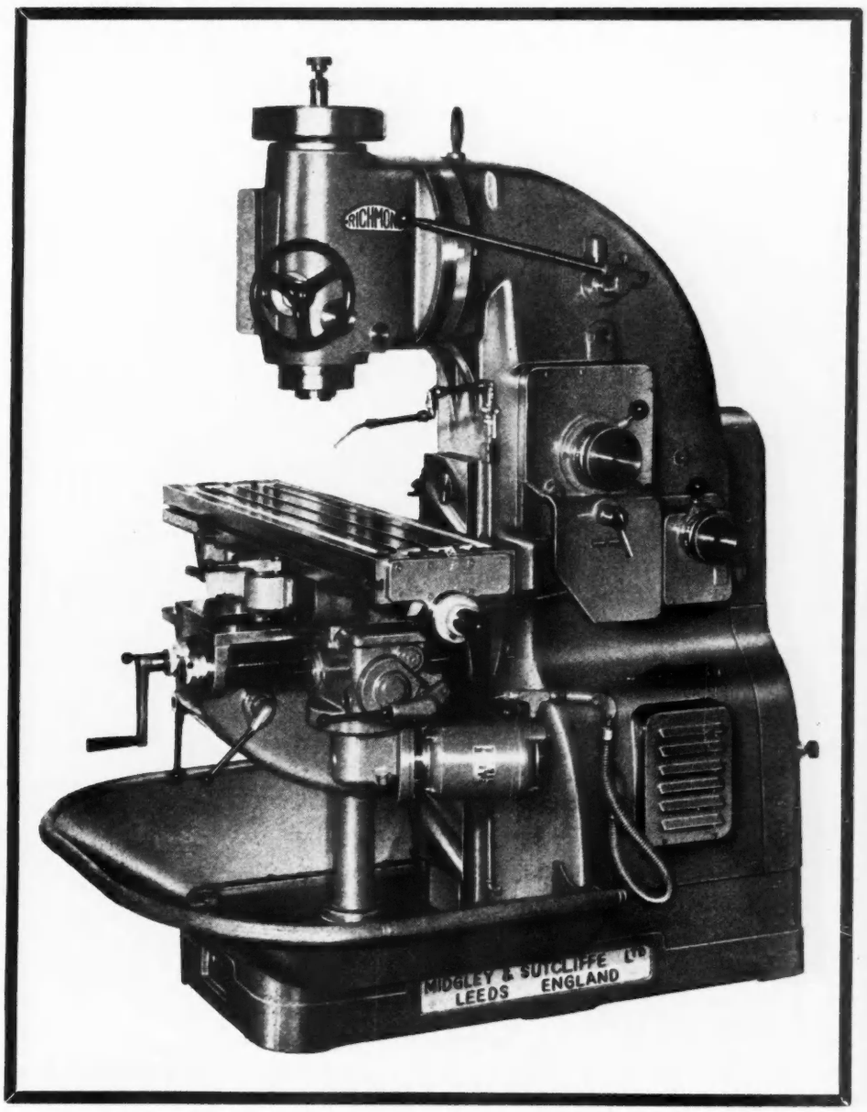
GUEST KEEN IRON & STEEL COMPANY LIMITED

HEAD OFFICE: EAST MOORS, CARDIFF. *Phone: Cardiff 33151*

Enter No. 642 on reply card

RICHMOND *range the world over!*

Speed, rigidity, flexibility. These are the basic points that the discerning buyer looks for in a machine tool. But these essential qualities don't just "happen"—in the case of the famous "Richmond" range of Milling and Drilling Machines, they are factors built-in at the blue-print stage by an expert design team and then translated patiently into reality by some of the finest craftsmen in Britain's industrial North.



No. 3 VERTICAL MILLING MACHINE
Table Size: 48" × 11".
Capacity: 30" × 8" × 16".
12 Speeds—12 Feeds.
Automatic & QPT. to all motions.
Spindle Bored No. 40 B.S.S.T.
Head Swivels 45° Right or Left.
3" Vertical Spindle adjustment.

RICHMOND MILLING AND DRILLING MACHINES

MIDGLEY & SUTCLIFFE LTD.

Hillidge Works, Hunslet, Leeds 10, England Telephone: 76032/3 Telegrams: 'Tools, Leeds, England

THE 600 GROUP OF COMPANIES

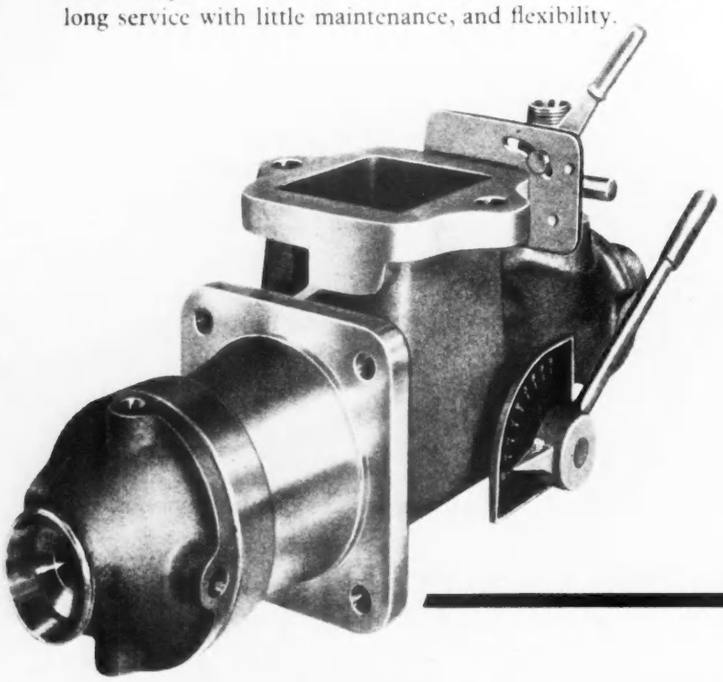
Enter No. 651 on reply card

The Burner shown has a maximum output of 12 gallons per hour and requires atomising air at 20" (51 cm) w.g. to 30" (76 cm) w.g. with oil at not less than 5 lbs per sq. in. (0.35 kgs. per sq. cm.) or equivalent head.

Made to Measure

WALLSEND SELF-PROPORTIONING LOW AIR PRESSURE BURNER

- . . specially designed so that the fuel output and air/oil ratios are under complete control.
- . . provides fingertip, single lever control for accurate and efficient regulation.
- . . automatically ensures a correct mixture of air and oil over a wide range irrespective of the type of fuel in use.
- . . has a turn down range of approximately 5 : 1 which can be achieved with a stable flame, efficient combustion and a high CO_2 content.
- . . leads the way to automatic or remote control of single and multi-burner installations.
- . . incorporates the well known Wallsend features of robustness, long service with little maintenance, and flexibility.



For more efficient

OIL BURNING

consult

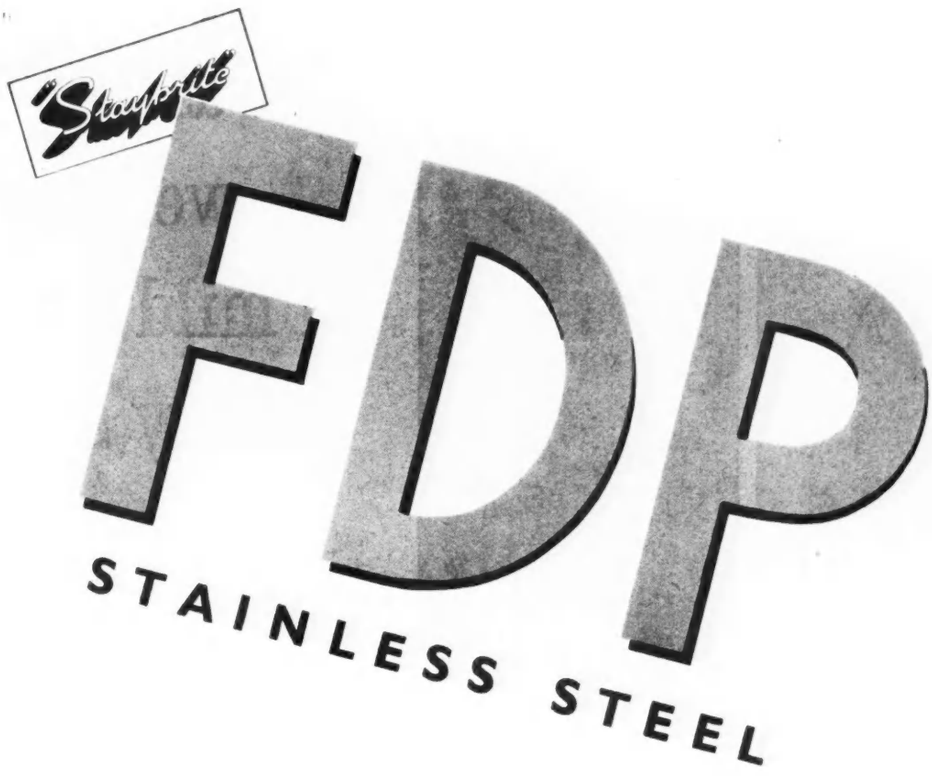
THE WALLSEND SLIPWAY & ENGINEERING COMPANY LIMITED

WALLSEND-ON-TYNE

NEARLY 80 YEARS OF OIL BURNING EXPERIENCE

Enter No. 661 on reply card

only FIRTH-VICKERS make



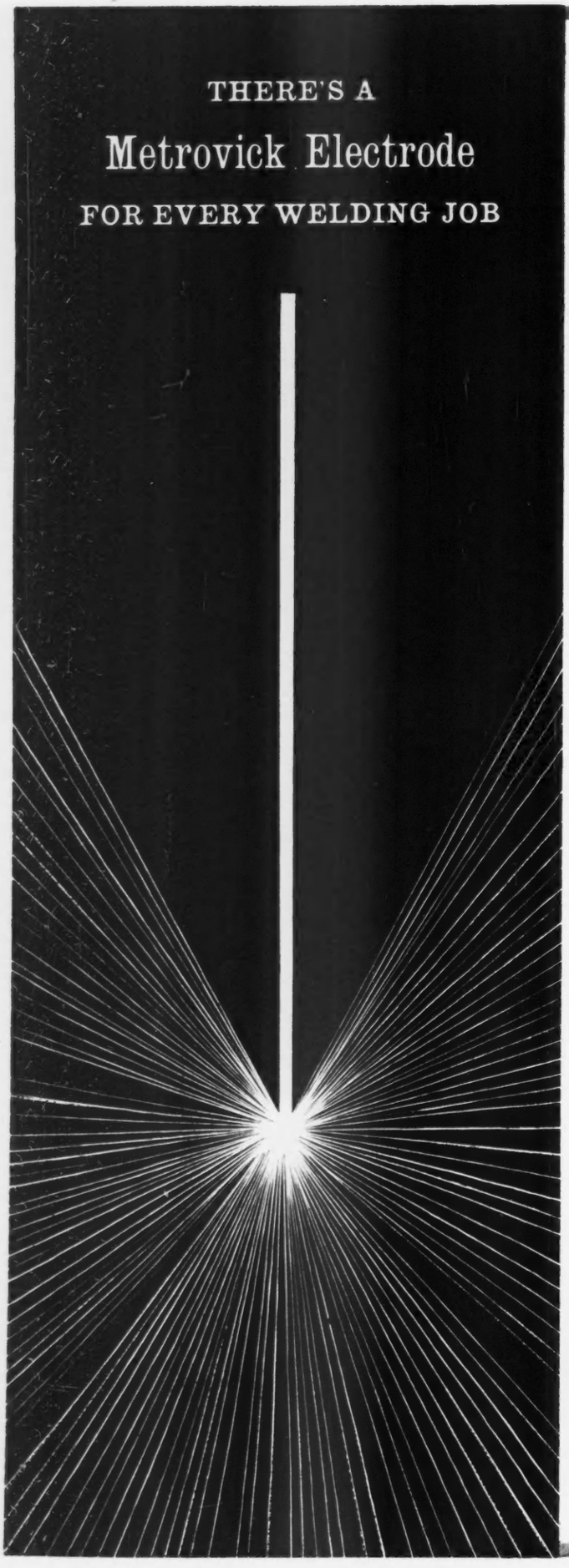
For over 27 years 'Staybrite' F.D.P. steel has been the standard material in the construction of a wide range of chemical plant. It is also used for storage and transport in the chemical, dairy and brewing industries, and is extensively applied in all types of power production.

Technical information on the use of all Firth-Vickers steels, together with technical literature are always available on request.

FIRTH-VICKERS STAINLESS STEELS LTD., SHEFFIELD

is the only Company in Europe to devote its activities exclusively to the production and development of stainless and heat-resisting steels.

Enter No. 671 on reply card



For all-position welding of mild and low alloy steels

THE

TENSIVICK 35V

- Tolerant to wide range of parent metals including low alloy, sulphur-bearing and silicon steels
- A low-hydrogen electrode suitable for A.C.
- Particularly suitable for welding heavy structures
- Effective but cheaper than austenitic electrodes
- Gives high purity deposit with exceptional mechanical properties
- Ductile and free from porosity
- Approvals include Lloyds, Ministry of Transport, and the Admiralty.

For full technical details write for descriptive leaflet 787/22-1

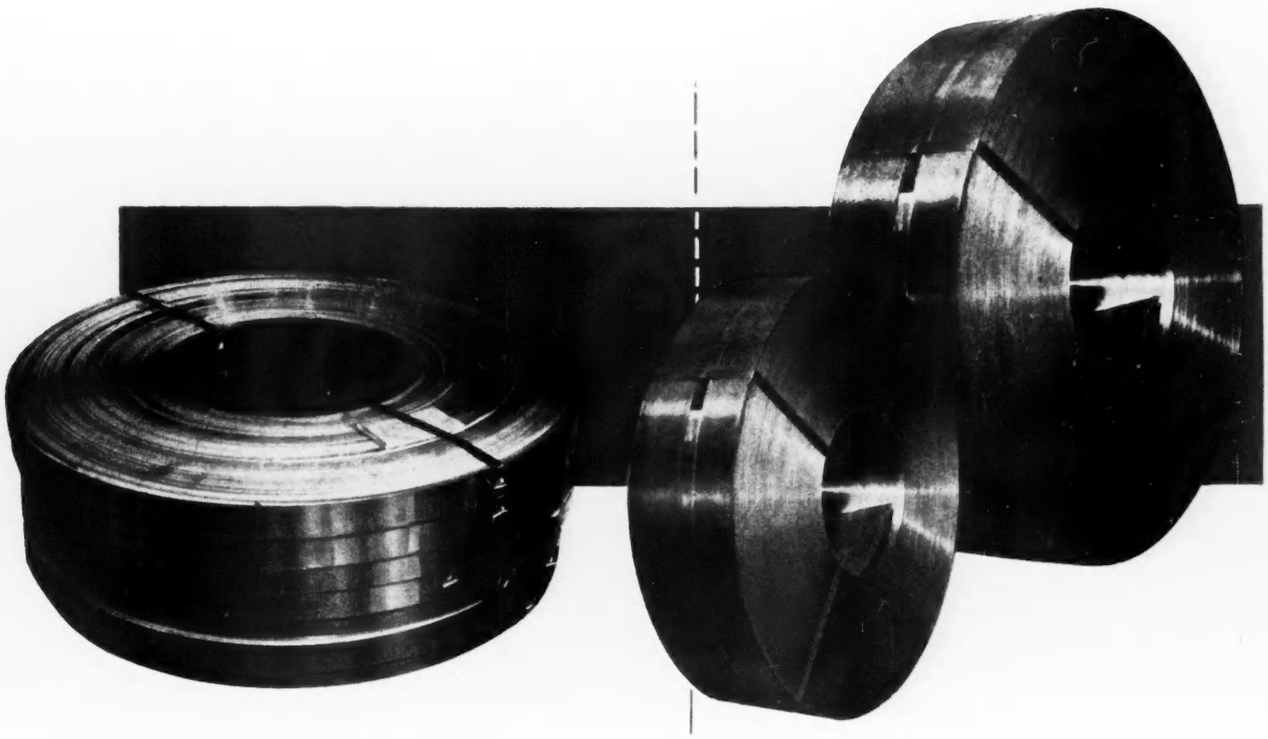
THE METROVICK RANGE OF 'GIANT BUILDER' ELECTRODES INCLUDES

EH · SYLVICK · MINIVICK · UNIVICK · SPEEDIVICK
VERTIVICK · NICHROVICK · PYROVICK
CASTIVICK · P250 · MOLVICK · LOCREEP
VANDIVICK

Associated Electrical Industries Limited
TRANSFORMER DIVISION — HEATING & WELDING DEPARTMENT
Trafford Park - - - Manchester 17

L/PB05

Enter No. 681 on reply card



OUR COMPANIES: Altenessener Bergwerks-AG Essen-Altenessen · Hoesch Bergwerks-AG Dortmund · Hoesch-Westfalenhütte AG Dortmund · Hoesch Walzwerke AG Hohenlimburg · Zweigniederlassung Werk Federstahl Kassel · Dörken AG Gevelsberg i. W. · Dortmunder Drahtseilwerke GmbH Dortmund · Schmiedag AG Hagen i. W. · Zweigniederlassung Werk Ruegenberg Olpe i. W. · Schwinn AG Homburg Saar · Trierer Walzwerk AG Wuppertal-Langerfeld und Trier · Maschinenfabrik Deutschland AG Dortmund · Hoesch Rohrwerke AG Hiltrup und Hagen i. W. · Becke-Prinz GmbH Dortmund und Hemer · Rheinischer Vulkan Chamotte und Dinaswerke mbH Oberdollendorf Rhld. · Hoesch Eisenhandel mbH Dortmund · Hoesch Reederei und Kohlenhandel GmbH Essen-Altenessen · Hoesch Düngerhandel GmbH Dortmund · Hoesch Export GmbH Dortmund · Hoesch Limited London · Hoesch Italiana SpA Mailand · American Hoesch Inc New York · Industriewerte AG Dortmund

PRODUCTION PROGRAMME: Coal, Coke and all by-products · Rolling mill products of every kind, hot rolled, cold rolled and drawn · Commercial quality steels · High quality steels · Free cutting steels in the well-known Hoesch-Autax qualities, black and bright drawn · Permanent way material · Steel sheet piling · Drawn Iron- and Steel wire of every kind · Springs of every kind · Forgings and pressed parts of every kind for the motor industry, for building and mining industries and machinery · Iron castings up to 30 tons · Special castings Sphaero-castings · Grinding media · Wire netting and wire cloth · "Agil" welded electrodes · Wire ropes · Cold rolled strip in all qualities and surface-finishes · Strip in coils up to 1330mm. · Plates and medium plates · Commercial sheets · High quality sheets · Welded gas-, water- and oil-pipes · Welded boiler tubes · Welded precision tubes · Electrical conduit tubing · Steel tube column · Both sides Hoesch spirally welded tubes · Hoisting gears · Coke oven equipment · Switches and crossings of every kind · Heavy duty machine tools, including the largest types.

HOESCH WERKE AG DORTMUND

Please send enquiries to:—**HOESCH LTD. 30/32 GRAY'S INN ROAD, LONDON, W.C.1** Telephone: CHAncery 2068

Enter No. 691 on reply card

Klinger

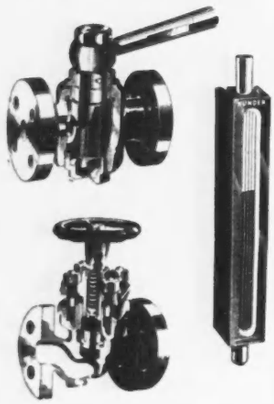
KLINGERIT

the universally used jointing for superheated and saturated steam at highest pressures and temperatures. Suitable also for hydraulic pressures, compressed air and other gases, acids, alkalis and chemicals generally, oils, spirits, solvents and other hydro-carbons. Special jointings are available for particularly difficult applications.

Joint-cutting service

Users increasingly are taking advantage of the Klinger cut-joint service and are buying their joints ready cut from the Klinger Works. In doing so they save trouble and expense, ensure the greatest degree of accuracy, and gain the advantage of speedy supply.

METAL FITTINGS DIVISION



VALVES

Klinger supply a wide range of improved seatless piston valves which operate on an entirely different principle from the more usual type of seating valve. The non-metallic valve rings are resistant to steam and oils, are adjustable in use and easily replaced. Other Klinger valves include the Streamline Piston Valve which offers a free and unobstructed flow to the passage of fluids, and Disc Valves with specially designed renewable discs.

COCKS

Klinger Sleeve-Packed Cocks have been renowned for the past 25 year's since when they have steadily replaced the formerly-used asbestos-packed cocks.

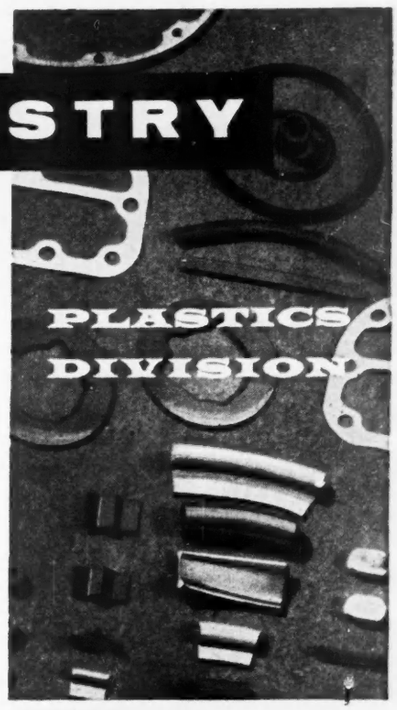
GAUGES

Klinger were the inventors of the Reflex Water Level Gauge for boilers. They supply the widest range of gauges for indicating the level of all liquids, to a variety of specifications.

From the very outset, the history of Klinger has been one of technical accomplishment. As long ago as 1886 they pioneered the original compressed asbestos jointing known throughout the world as 'Klingerit'. A tremendous advance in those days, Klinger jointings are now universally specified to meet the most exacting demands of every industry.

The knowledge gained from the use of 'Klingerit' was applied to remedying the limitations of other industrial units such as cocks and valves, and today the name of Klinger comes immediately to mind whenever industry calls for materials capable of withstanding extreme operating conditions. Here are some of the many products for which Klinger is known everywhere.

SERVICE IN INDUSTRY



KLINGERFLON

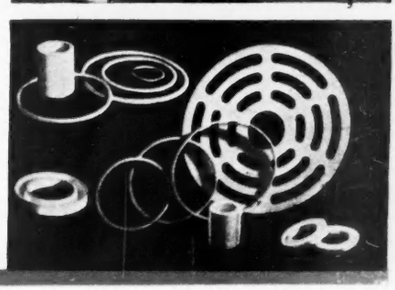
The most chemically inert material commercially available, 'Klingerflon' has excellent electrical properties and can be used over a wide range of working temperatures. The combination of chemical inertness and a low co-efficient of friction makes 'Klingerflon' ideal for use as a gland packing and chemical seal. 'Klingerflon' is widely used, particularly by the chemical and electrical industries.

SILICONE RUBBERS

Klinger-made silicone rubber and the synthetic rubber developed in their own laboratories are used by almost every industry and by atomic energy plants and other government projects.

★ ★ ★

Write for full details and catalogues. Our Representatives are always at your service to assist and advise on the use of Klinger products.

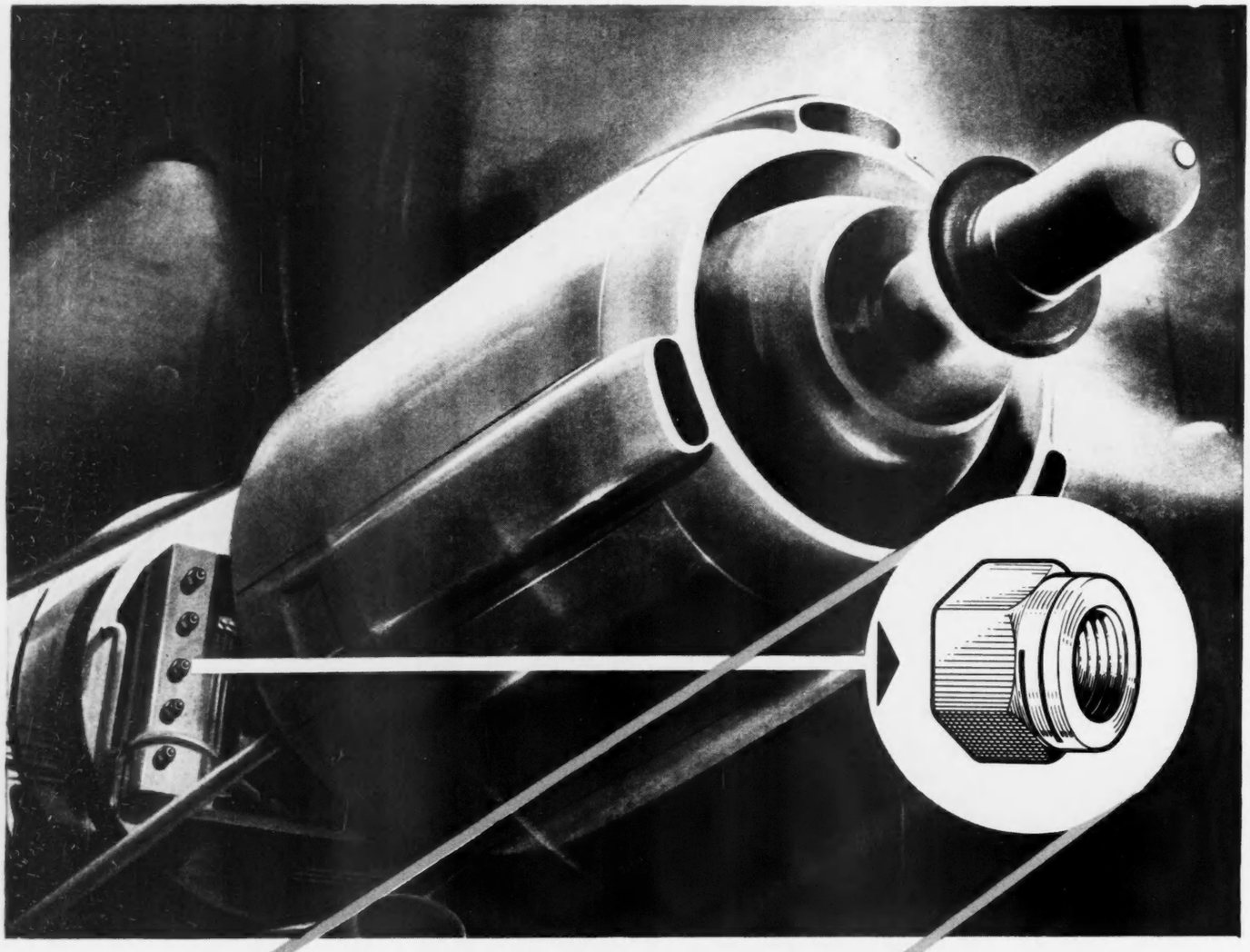


Klinger

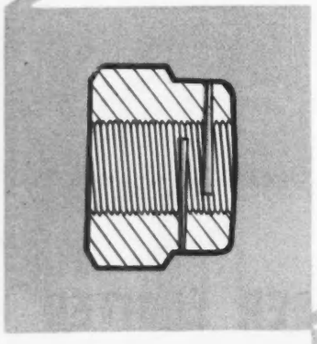
RICHARD KLINGER LIMITED
Klingerit Works
SIDCUP, KENT. ***Tel: Footscray 7777***

Enter No. 711 on reply card

FANTASTIC TENACITY...



YOU CAN SAY THAT AGAIN!



Fantastic tenacity! That's the reaction of Philidas Self-locking nuts to every degree of vibration . . . heat change . . . oil infiltration or constant use. Their amazing steadfastness is due to an ingenious opposing torque cross-cuts feature which sets up a tension that only a spanner can release. The range of Philidas Self-locking nuts includes standard and thin industrial and turret nuts, capped nuts, single and double anchor nuts

THEY YIELD ONLY TO A SPANNER

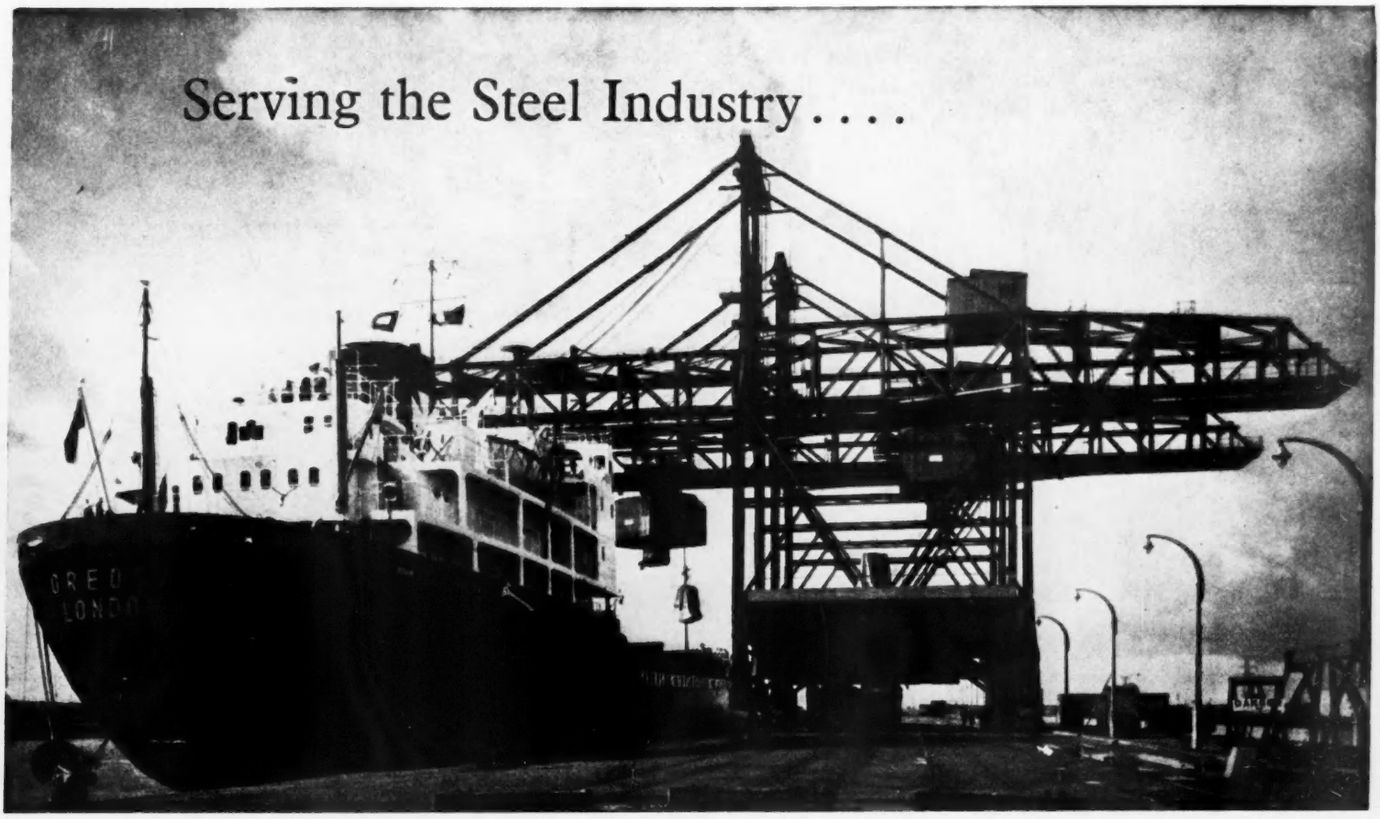
Send for new catalogue to:
PHILIDAS DIVISION
WHITEHOUSE INDUSTRIES LTD
Ferrybridge, Knottingley, Yorks.
Tel: Knottingley 2323 (5 lines). Telex 55166

PHILIDAS

SELF LOCKING NUTS

LONDON OFFICE: 44 Hertford Street, W.1. Tel: LEGation 3589. Telex 26549. NORTHAMPTON: Office and Stockroom, Countess Road. Tel: Northampton 3766. Telex 31624

Enter No. 721 on reply card



From ore unloading, hot metal pouring and section handling to shipping the finished product, the Clyde-Booth range covers the field of heavy materials handling for the Steel Industry.

Manufacturers of

Ore Transporters
Steelworks Cranes
Diesel Rail Cranes
Dockside Cranes etc.

CLYDE BOOTH

CLYDE CRANE & BOOTH LTD.

Incorporating:

Joseph Booth & Bros.,
Union Crane Works, RODLEY, Leeds.
Tel.: Pudsey 3168 (6 lines). Grams': "Cranes," Rodley, Telex. Telex 55159

Clyde Crane & Engineering Co.,
MOSSEND, Lanarkshire.
Tel.: Holytown 412 (6 lines). Grams.: "Clyde," Motherwell, Telex. Telex 77443

Enter No. 731 on reply card

Art or Industry?

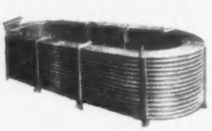
Both.

It's a copper dee for a cyclotron.

We made it. Lee & Wilkes Ltd. We can make anything in copper.

Coppersmiths.
Or smiths in any metal. Our workers (man and boy Lee & Wilkes men, *and* their dads and grandads) are craftsmen, using the best of traditional methods combined with modern techniques and up-to-date machinery. Art *and* industry, you see?

We fabricate pipes, make pipelines, plate and sheet products, extruded sections. We do Argon arc welding. We manipulate tubes, bend coils like



this copper transformer cooling coil, for instance. We're A.I.D. and A.R.B. approved, and we wish you could hear how proudly we say it!
Not cheap. Good work never is. But worth every copper.
Send for our literature.

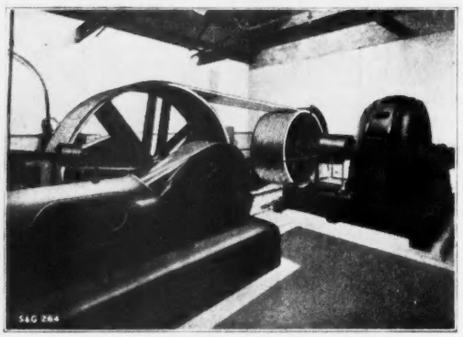
LEE & WILKES LIMITED
Smiths in any metal
PRIORY COPPER WORKS, BREWERY STREET, BIRMINGHAM, 6
Phone: ASTon Cross 2005-6-7 (P.B.X.)
Grams: Kettle, Phone, Birmingham

SPINNING, TOO! In any metal up to 7 ft. diameter blanks. Accuracy to ± .005.

Enter No. 741 on reply card

THRAPSTON

THRAPSTON V ROPE DRIVES
Keep the wheels of industry turning



400 HORSEPOWER COLLIERY DRIVE

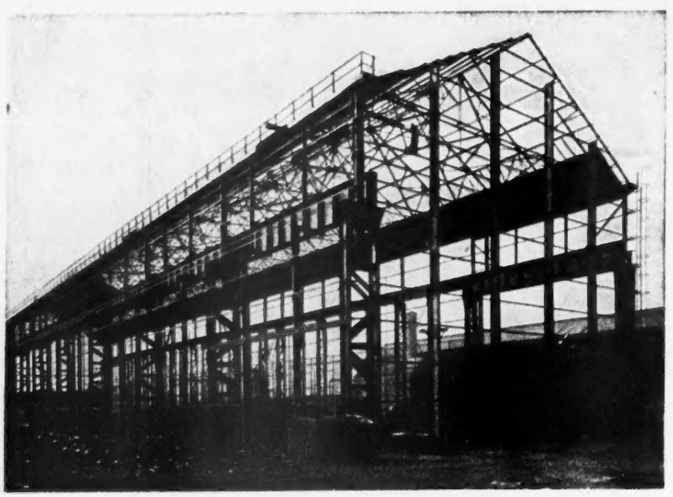
FLEXIBLE · EFFICIENT · RELIABLE
ECONOMICAL · SILENT · CLEAN

SMITH & GRACE LTD.
Thrapston · Kettering
Makers of Power Transmission Appliances for over a Century

TELEPHONE: THRAPSTON 109 & 110
TELEGRAMS: GRACE, THRAPSTON

Enter No. 742 on reply card

Steel Structures



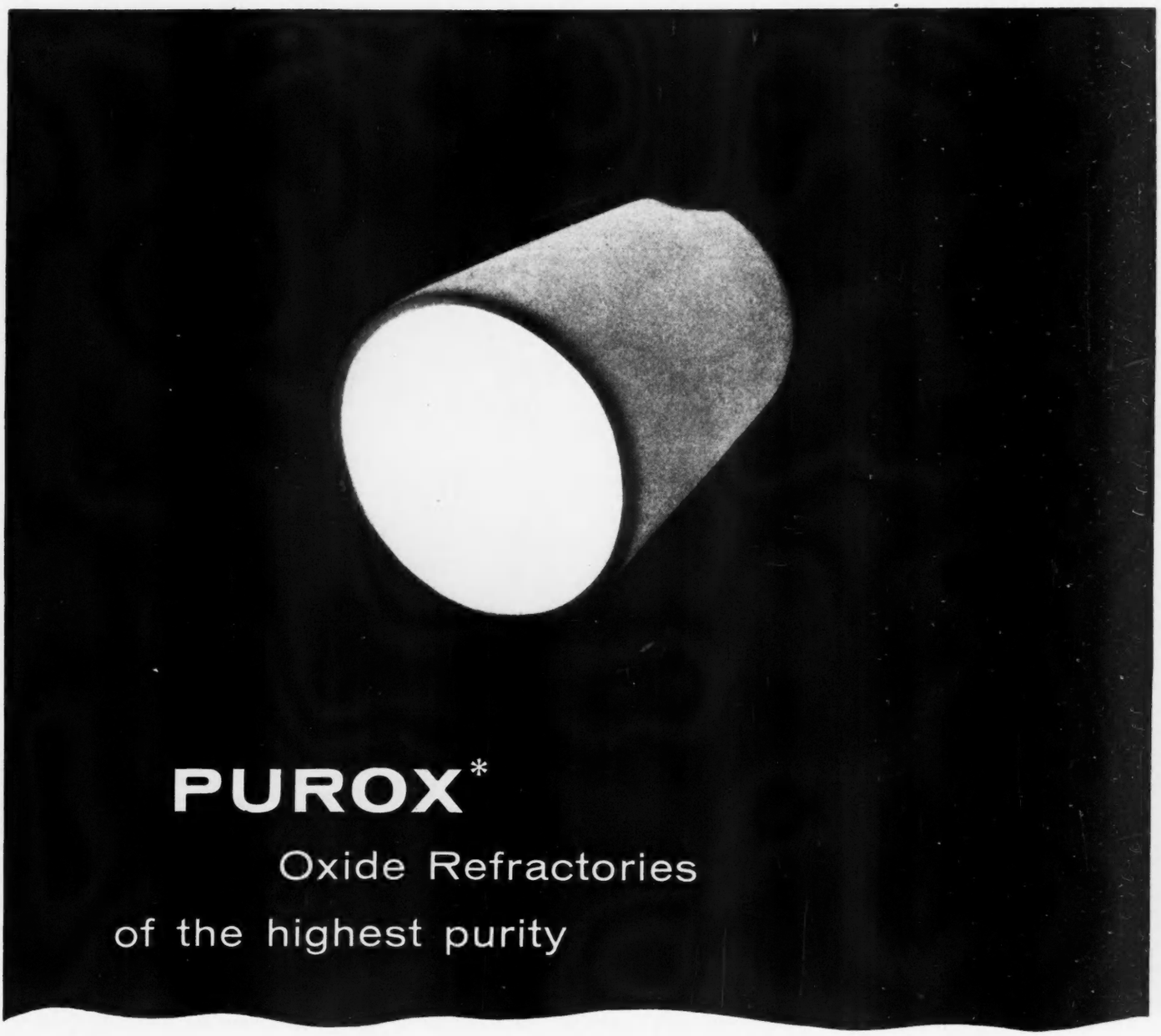
A. & J. MAIN & CO. LTD.

CLYDESDALE IRON WORKS,
POSSILPARK,
GLASGOW, N.2.
TELEPHONE: POSSIL 8381

VINCENT HOUSE,
VINCENT SQUARE,
LONDON, S.W.1.
TELEPHONE: VICTORIA 8375

CALCUTTA CHITTAGONG NAIROBI

Enter No. 743 on reply card



PUROX*

Oxide Refractories of the highest purity

RECRYSTALLISED ALUMINA 99·7%
STABILISED ZIRCONIA 97%
PURE MAGNESIA 98·5%
IMPERVIOUS THORIA 99·9%
THORIA 99·9%

Recent development work at Neston has resulted in laboratory ware in these highly refractory materials becoming available to a greater degree of purity and in a wider range of shapes and sizes than has hitherto been possible.

These Pure Oxide refractories open up new possibilities in high temperature work, whether it is to be done in a laboratory or on an industrial scale.

MORGAN Refractories Ltd

MORGAN REFRACTORIES LIMITED, NESTON, WIRRAL, CHESHIRE. TEL: NESTON 1406 *Registered trade-name applied for. N.E 147/A

Enter No. 751 on reply card

Stop that water waste!

with Prestex non-concussive spring taps

Thousands of gallons of water may trickle away in large public buildings, factories, schools, hotels and ships from taps not turned off completely. Hot water, especially, is expensive.

Prestex non-concussive spring taps are a sure answer to this costly irresponsibility, a big problem *particularly* shown in its true light in times of drought. Models available include:

876B
(with the NEW '3D' style button top)
½" Pillarcock. 3" nose and tail.

- Non-concussive self-closing action
- Light pressure only required to operate
- Strong black non-heating button top (with '3D' style red and blue inserts for "Hot" and "Cold") making it difficult to tie down or wedge open the valve
- Self-regulating to any pressure up to 100 lb. per sq. in. Each tap fully tested on water pressure
- As easy to re-washer as an ordinary tap
- Chromium finish on a heavy nickel base

Approved by all large Water Authorities.

Peglers Limited
The name is the guarantee

BELMONT WORKS · DONCASTER

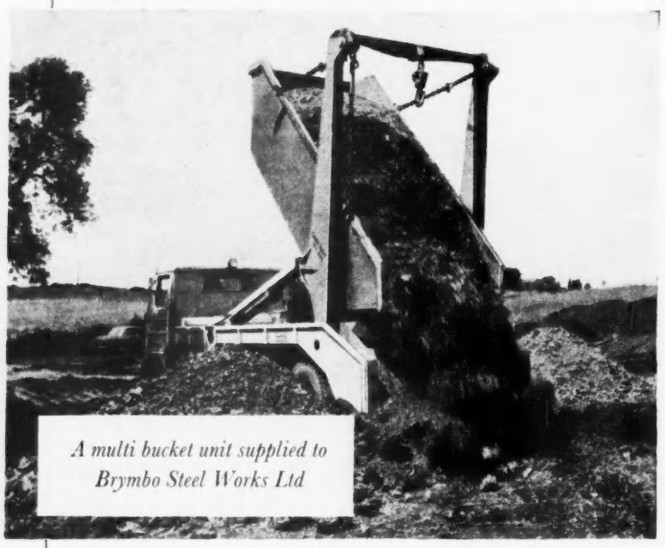
London Office and Warehouse: PRESTEX HOUSE · MARSHALSEA ROAD · S.E.1
and at 28 THORP STREET, BIRMINGHAM, 5

TGA WF61

Enter No. 761 on reply card

New concept of bulk handling

Bennes Marrel units for planned operations



A multi bucket unit supplied to Brymbo Steel Works Ltd

Bennes Marrel units revolutionise bulk handling with their system of multi-buckets used in conjunction with a truck that features built-in hydraulic lifting gear. Amazing economies of time and labour are being effected in the handling of a wide variety of bulk materials. Now being operated by **Steel Companies, Chemical Companies, Oil Refineries, Contractors, Scrap Merchants, Machinery Manufacturers and Refuse Collectors.**

Bennes Marrel Multi-Buckets Standard Unit
A standard truck chassis is adapted to incorporate hydraulic lifting gear. It can then load and unload itself with detachable buckets, and transport them between loading and unloading points. By operating with the optimum number of buckets, maximum efficiency with complete elimination of time-wasting can be achieved. All the loading and unloading operations are controlled by the truck driver from his cab.

4th repeat order—Trinoil (UK) Ltd controlled by Texaco Inc.— for operation at Texaco, Trinidad

Bennes Marrel Multi-Crane Unit
This model incorporates all the features of the Standard Unit PLUS the advantages of a mobile crane. A third ram actuates the cable of a lifting boom. The forward/backward motion of the arms combined with the raising/lowering of the boom permits perfect precision in placing the load in exact position. This unit performs the duties of a tipper truck and mobile crane.

Operated by R. S. Hayes Ltd, Admiralty Ship Breakers, Bridgend

Bennes Marrel Elevated-Buckets Unit
Longer lifting arms enable this unit to elevate the loaded Multi-Buckets to 15 ft. off ground and tip at 49° and unload the contents direct into railway trucks or road transport trucks from their elevated position.

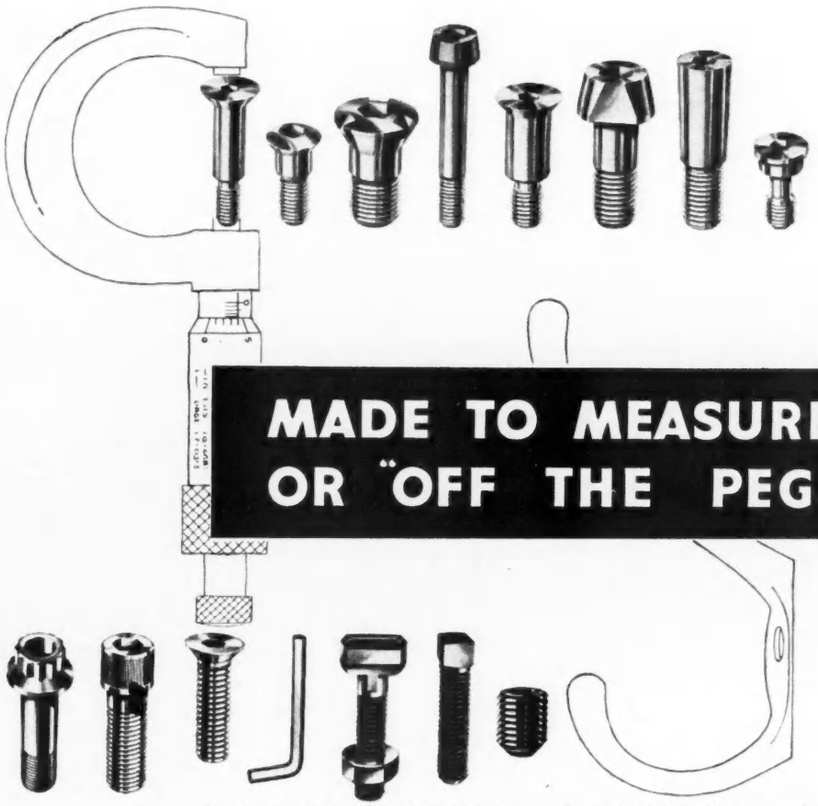
A member of the ARUSHA group of companies

AERO MAINTENANCE EQUIPMENT LIMITED

47 VICTORIA STREET · LONDON SW1

Smee's A.M.2

Enter No. 762 on reply card



MADE TO MEASURE OR "OFF THE PEG"

You can nearly always find a screw in the vast Unbrako range calculated to do just what you want better than any other screw.

But modern developments sometimes call for special screws not even standard to Unbrako.

When that happens our highly trained team of fastener-minded experts really get enthusiastic, responding to the challenge. They like to co-operate with you at the blueprint stage for preference, helping to design the perfect screw for the job, or they will simply make the screw to your specification, just about as well as a screw can be made.

So, standard or special, you can always safely specify Unbrako, the people who offer the most comprehensive specialised screw service in the world.

To be on the safe side, better get in touch with Unbrako over any fastener question. Remember what they say — Unbrako screws cost less than trouble.

There are two Unbrako lists you should have in your library, and a postcard or telephone call will bring them by return. They form a detailed and comprehensive guide to the whole Unbrako range, standard and non-standard, and no progressive firm should be without them.

Unbrako screws cost less than trouble

UNBRAKO

UNBRAKO SOCKET SCREW COMPANY LIMITED · COVENTRY · Tel: 89471

Enter No. 771 on reply card

MICA

ESTABLISHED 1840

FOR

INSULATION

WATER GAUGES

ETC.

F. WIGGINS & SONS

9-11 TREDOWN RD., SYDENHAM, S.E.26

Tel: SYDenham 7660

Enter No. 772 on reply card

BRIGHT DRAWN STEEL

BRIGHT TURNED BARS

(UP TO 18" DIAMETER)

BLANKS

MILD STEEL

FREE CUTTING

CASE HARDENING

HIGH TENSILE—

to all carbon steel specifications

On Admiralty Ministry of Supply Rly. Executive, A.I.D. Etc. Lists

GOVAN SHAFTING & ENGINEERING CO.

87 HELEN ST GOVAN GLASGOW

(Prop: The Steel Company of Scotland)

Enter No. 773 on reply card

MALLEABLE IRON CASTINGS

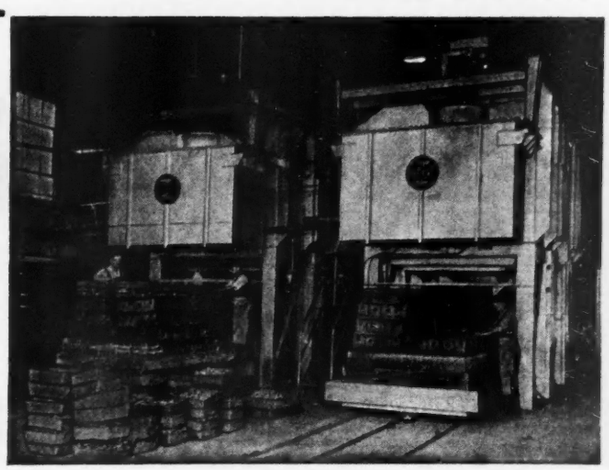
ANNEALED IN THE MOST MODERN GASEOUS DECARBURISING PLANT

Excellent Physical Properties

From:

PLATT MALLEABLE CASTINGS LTD.

CLIVE FOUNDRY . LEAMORE · WALSALL



Enter No 774 on reply card

THE
SKERNE WORKS
LIMITED
ALBERT HILL, DARLINGTON
Tel: DARLINGTON 5612

•

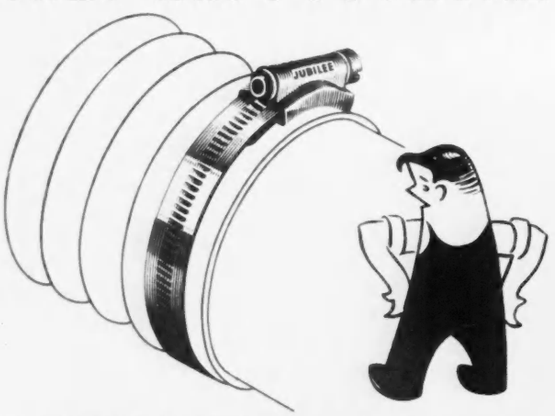
PRESSINGS
PRESSED SECTIONS
COLD FORMED SECTIONS
FABRICATIONS
MACHINED PARTS
IN ALL METALS

•

All enquiries promptly dealt with

Enter No. 781 on reply card

THEY CAN'T FOOL ME!

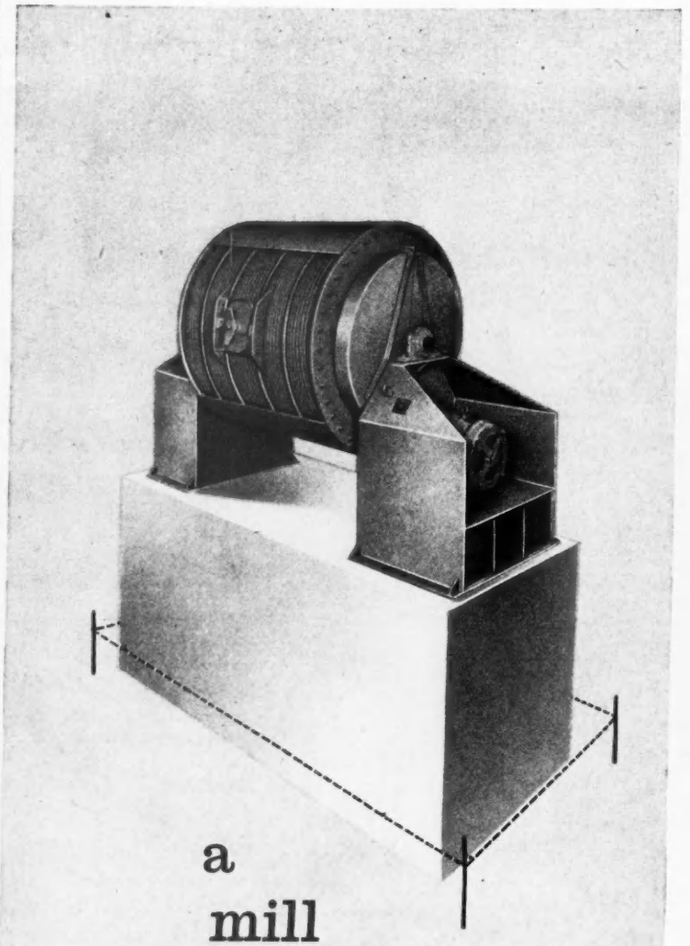


I LOOK FOR THE NAME
TO MAKE *SURE* THEY'RE

GENUINE *Jubilee*
REGD. TRADE MARK
WORM DRIVE HOSE **CLIPS**

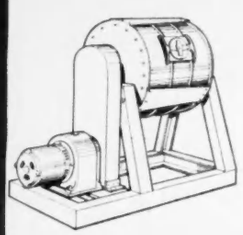
L. ROBINSON & CO., (Gillingham) LTD.,
LONDON CHAMBERS, GILLINGHAM, KENT. TEL: GILLINGHAM 51182/3

Enter No. 782 on reply card



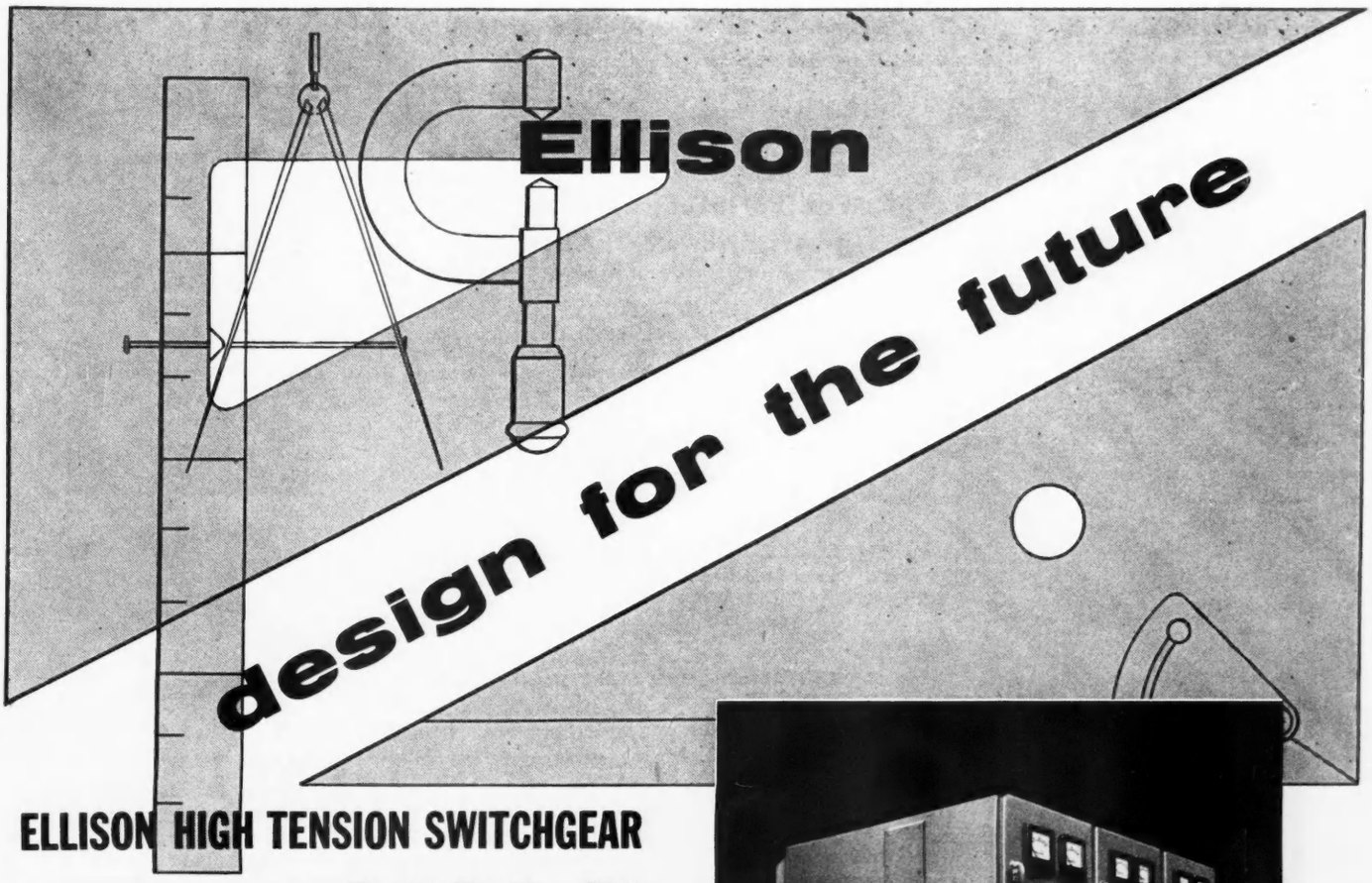
a
mill
in
a
million

A Linatex Ball Mill has many times the life of the conventional type. It's the only mill with a cylinder of compressed Linatex reinforced with tie rods. It grinds faster, finer, quieter. The milled contents of the drum can't be contaminated. No metal is exposed internally.
Here's a mill in a million, a low-cost capital investment. Six types available. Why not ask our Resident Engineer in your area for details, or send for free copy of the Linatex Ball Mill brochure?



THE LINATEX ORGANISATION
A world-wide service to Industry.
WILKINSON RUBBER LINATEX LTD., CAMBERLEY SURREY
Tel. Camberley 1580. Factories and Distributors throughout the world

Enter No. 783 on reply card

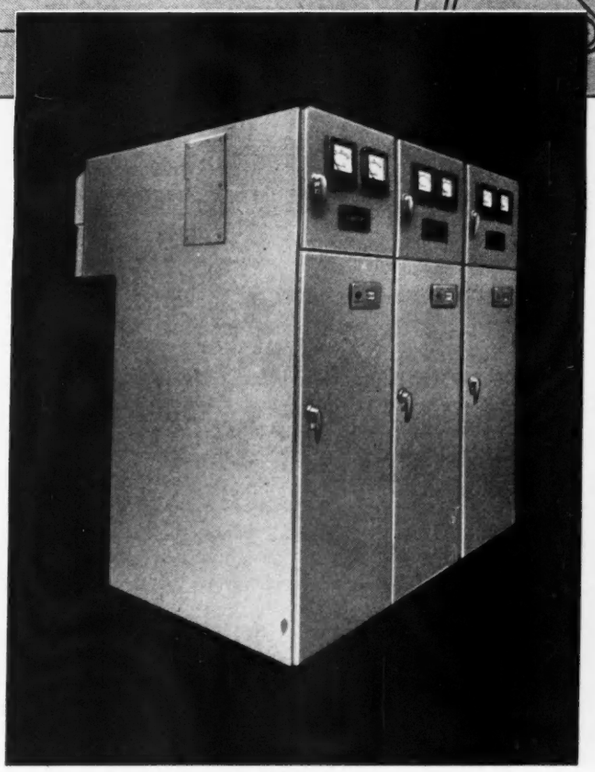


ELLISON HIGH TENSION SWITCHGEAR

complies with B.E.B.S.-S2 250 MVA ADDENDUM

Here is a typical example of forward thinking by Ellison designers. Ellison High Tension Switchgear was originally designed to comply with B.E.B.S.-S2 (1955). Yet it also complies with the recently published 250 MVA Addendum

(without modification of the original design.)



11kV 250 MVA – 3.3kV 150 MVA

ASTA CERTIFIED TO B.S. 116:1952
(Cert. Nos. 3990-1)

WIDTH ONLY 24″ YET ALL PARTS EASILY ACCESSIBLE

LONG LIFE CONTACTS— HAND OR POWER CLOSING

AIR-INSULATED BUSBARS

INDIVIDUALLY SEALED OFF BUSBAR CHAMBERS

and many other features that mean so much to you

TRADE MARK

GEORGE ELLISON
LIMITED

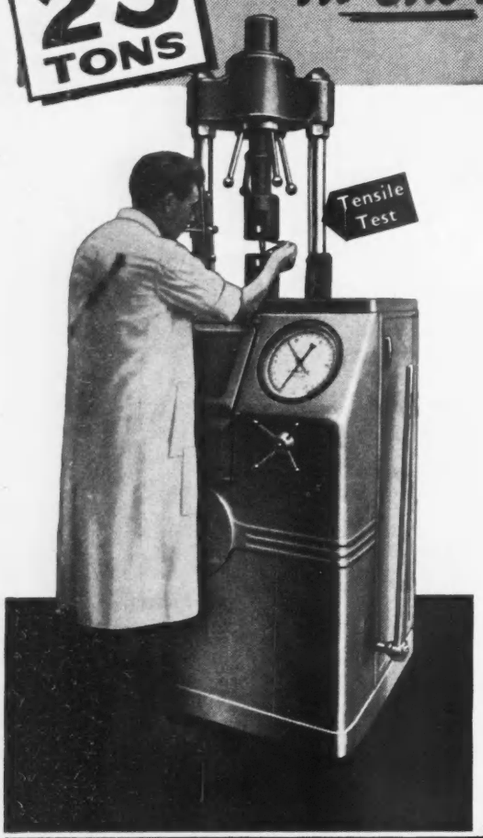
PERRY BARR · BIRMINGHAM · 22B

842
Enter No. 791 on reply card

25 TONS

AT LAST a TESTING MACHINE

that ALL MANUFACTURERS CAN AFFORD



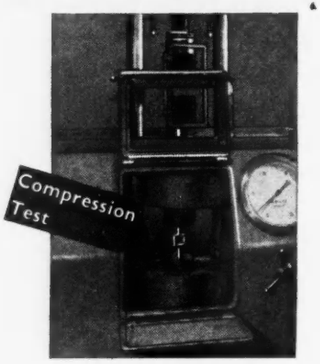
For TENSILE, COMPRESSION, BEAM, SHEAR & BENDING TESTS

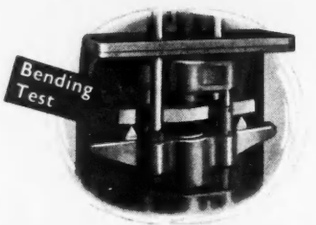
It is the cost of most testing machines which restricts their use to the larger companies. Careful consideration to design has enabled this machine to be produced to a lower figure and the benefit is passed to the user.

Different principle of construction and a new method of load indication have been adopted, while certain refinements, so necessary on specialised testing and research work but seldom called for on normal production jobs, have been omitted. Hand operated or motor driven models are available.

The head measuring device is entirely separate from the hydraulic system and the indicating dial is readable to the nearest ½ cwt. This gives an indication of the accuracy of the machines, for at loads over 2½ tons the accuracy of the machine is within one per cent or better. Ask for catalogue 797 P1A.

AN IDEAL MACHINE FOR STUDENT TRAINING!





TANGYES LIMITED

SMETHWICK · BIRMINGHAM · Phone SME 1181

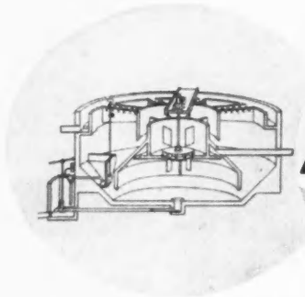
AREA OFFICES AT LONDON · MANCHESTER & GLASGOW FOR EXPERT ADVICE

AD. NO 68.

Enter No. 801 on reply card

Good water is priceless...yet it costs so little!

Good water, for industrial processes and product manufacture, is priceless. Yet it costs so little when supplied by the Accelator, the water treatment system made by Paterson. For the Accelator gives an unfailing supply of soft, clear, colourless water with supreme economy of operation. Besides such economical operation, the Accelator has these other money-saving features: *small tank area · shallow tank construction low-cost installation · automatic operation · reduced retention time.* All of them make the cost of Accelator good water something you should know more about: as indeed you can by writing for details.



Accelator ...*soft, clear water*

THE PATERSON ENGINEERING CO. LTD., 129 KINGSWAY, LONDON, W.C.2.

Enter No. 802 on reply card

THE ENGINEER

No. 5410 OCTOBER 2, 1959 VOL. 208

THE DELTA SCHEME

" Directing the great sources of power in nature for the use and convenience of man " may, at times, seem a rather pretentious definition of the civil engineer's profession, particularly for those who happen to have become bogged down in mundane or routine matters. But now and then one comes across some project which, by the breadth and mastery of its conception or by the skill of its execution, brings to life that grandiloquent phrase. Such a project is the Delta scheme, the most ambitious of the coast protection schemes ever undertaken in Holland, which we describe in articles in this issue. Nowadays we have become accustomed to civil engineering schemes built on a really vast scale, so the Delta scheme is not by any means unparalleled in overall expenditure. For instance, the combined power and navigation works of the St. Lawrence Seaway cost almost twice as much as the estimate for the completed Delta scheme, and were completed in four and a half years against about twenty-five years estimated for the latter. Where the Delta scheme is unique is in its purely civil engineering content —the achievement of building dams in the open sea and with sand as the main constructional material. Technical originality and boldness are the attributes which characterise it, whereas speed of construction and a vast deployment of economic resources, using accepted constructional practices, characterised the larger St. Lawrence River works. Even so, the Delta scheme can be equalled in size by very few projects, and its cost is being borne by a comparatively small national economy. This heavy national burden is accepted with the confident expectation of security and profit from the completed scheme.

The Delta scheme is particularly instructive as an example of the variety of activities and influences which go into the successful creation of a civil engineering project. The art of reclamation in Holland is traditional, but the scope of contemporary works has been vastly extended by an evolutionary blending of modern advances into the traditional practices. We find, for example, that the sluice gates and main beams of Haringvliet dam will be advanced examples of contemporary structural design. Yet the willow mattresses employed ubiquitously on these works are traditional and so satisfactory that only very recently, as we describe in one of the articles, has an attempt been made to replace them for certain specific duties. The broad range of accomplishments which fall within the civil engineers' scope is also well illustrated. On the one hand is the highly academic business of hydraulics research, which includes such abstruse subjects as investigation by electrical analogy into the tides in the Haringvliet. On the other hand is the hard-headed, intensely practical business of creating a small island, virtually of loose sand, in the middle of a blustery wind-swept sea channel.

Like all of the greatest civil engineering ventures, experience has played an important role in shaping the final concept and its method of execution. The scheme is in many respects a continuation of the same general concepts as were applied so successfully in the reclamation of the Zuider Zee, but the situation generally and the principal aims of the Delta scheme are rather different, as our article explains. What lessons are to be learned in this country from the scheme ? The surge barrage on the Hollandsche Ijssel River will be of great interest to those concerned with implementing the Waverley committee's suggestion for a similar structure in the Thames estuary, and the standard of sea defence afforded by the scheme will also be studied by engineers concerned with such work here, as well as the detailed technical design. But the greatest lesson, in our opinion, lies in the example of the scheme as a comprehensive exploitation of a natural problem. We were going to say " a natural resource," but this is scarcely the correct term ; rather it is the overall natural situation—in this case the complex of the river delta, the vulnerability to flooding, and the water supply problem—of the region which has been appraised and modified. This sort of approach is not unique—the parallel example of the Tennessee Valley development has been widely publicised, for instance—but it is just one example of the great things which are capable of being achieved in the twentieth century by imaginative planning and sound allocation of financial and technical resources.

FUEL FOR POWER

Elsewhere in this issue we give a short summary of the annual reports for 1958–59 of the Electricity Council and of the Central Electricity Generating Board. These reports of the progress made by the two bodies that on January 1, 1958, became responsible for the electricity supply industry in England and Wales are available for those who wish to make a close study of them and we propose to limit our comments to some of the introductory remarks made by Sir Christopher Hinton at last Tuesday's Press conference when the reports were discussed. We do so because the questions at issue are of fundamental importance.

Sir Christopher said that one of the basic problems claiming the attention of the C.E.G.B. concerned the long-term fuel policy of the supply industry. He pointed out that for the sound development of the power programme it was necessary to evolve a balance, on an economic basis, of the three main fuels available to power stations in England and Wales—coal, oil, and nuclear. The oil-burning programme was determined by existing contracts that were initiated in 1953–54 to meet a prospective shortage of coal and were modified in 1957 and 1958 to take advantage of more favourable estimates of the coal supply. About a year ago the C.E.G.B. decided to rearrange the programmes for nuclear and conventional stations for 1963–66 to give less nuclear development in the earlier period and more rapid build-up later. One result of this decision was to defer by a year the nuclear power station at Dungeness. It was estimated that by March, 1965, about 80 per cent of the Board's electricity output would be from coal-fired stations (compared with 86 per cent in 1958–59),

11 per cent from nuclear plant, and 8 per cent from oil. Looking further ahead Sir Christopher said that the Board was confronted with a pressing problem in trying to strike an economic balance between the three fuels for the plant programmes covering 1966–76. One factor that tended to upset earlier estimates was the very rapid technical advances that were being made in conventional stations : the point at which the generation costs of nuclear power stations would " break even " with those of conventional stations might be as late as 1970.

It is as well to acknowledge that, as long as adequate coal supplies are available, the choice between coal and nuclear fuels must, in the long term, be made on an economic basis. At present the conventional stations are setting the pace. It is a hot pace and it is good that it should be so because, as far as one can see into the future, power stations will need all the coal that they can get. There is no reason, either, to suppose that the pace of progress will be too hot for nuclear power stations. Indeed, technical developments have been made with such speed that the earlier nuclear stations have tended to become out-of-date even before they have been completed. The makers of nuclear power plant are faced with the intractable problem of trying to reduce capital costs when every part of every contract is a one-off job, when the best of to-day's designs are bettered to-morrow, and when the economics of various alternative methods of erection and construction must be estimated by intelligent guesswork rather than by precise analysis or past experience. How long will it be before designs and constructional procedures can be stabilised sufficiently to allow reasonably accurate costing of the job ? What will be the cost of uranium and other fuels in ten years' time ? Are the " guaranteed " ratings of the stations now being built or projected too conservative and, if so, by how much ? Questions of this sort are doubly difficult to answer in a new technology which is advancing so rapidly that one cannot freeze a design without appearing to arrest progress. We do not envy the C.E.G.B. in its task of weighing so many imponderables to reach a balanced fuel policy for its future power station programmes.

DEMARCATION DISPUTES

Stoppages of work arising from demarcation disputes constitute, possibly, the biggest industrial irritant of the day. This irritant has been particularly evident in recent years in the shipbuilding and ship-repairing industries, in which disputes over " who shall do what " seem so frequently to arise. Their effect is cumulative ; demarcation disputes involve far more people than the usually small numbers of workers directly concerned in them. Not only do these disputes mean serious production delays. Their triviality tends to lower the reputation of the industry in the eyes of its customers at home and overseas. Consequently, there can be no doubt at all about the over-riding need to eliminate demarcation disputes and, in fact, all practices which impair the British shipbuilding industry's competitive position. In the industry there are a number of unions which are parties to what is known as the 1912 Agreement, but there are several other unions which do not subscribe to that agreement. The fact that all the unions involved in shipbuilding and ship repair work are not parties to this 1912 Agreement has led to difficulties and interruptions of work which cannot be tolerated if the industry is to stand up to the increasing competition with which it is faced.

These matters have been discussed by the Shipbuilding Employers Federation and various constituents of the Confederation of Shipbuilding and Engineering Unions. Following these discussions, the Employers Federation has put before the executive of the union confederation proposals for dealing with demarcation disputes as speedily as possible *without interruption of work*. The intention was, and indeed still is, to formulate an agreement which it should be simple to operate. But an essential requirement is that " any work in dispute should continue to be carried out on the basis of the allocation current at the time when the dispute arises, until such time as a settlement is concluded in the terms of the procedure suggested." It is not an unreasonable requirement. Nevertheless, progress towards agreement on this revised and simplified procedure appears to be lamentably slow. Last week, the Shipbuilding Employers Federation met representatives of the Confederation of Shipbuilding and Engineering Unions, when the latter presented a claim for a wage increase and a shorter working week. During this meeting the subject of demarcation disputes was again raised. The president of the Shipbuilding Employers Federation, Mr. R. W. Johnson, said that a number of firms had thought there might be something to be gained from consultations with the unions concerned prior to introducing changed methods or processes. In some cases, he added, those talks had extended over many months but rarely had they resulted in any measure of agreement being reached. The experience of several firms had been, in fact, that the trades concerned " were getting further and further away from any idea of settlement the longer such discussions progressed and the meetings were generally discontinued by one party or another." Clearly, prior consultation has not always worked as a means of disposing of demarcation disputes and a great deal of important work has consequently been delayed by failure to reach a settlement before a contract was due to begin. In addition, Mr. Johnson has commented on " a large number of outstanding demarcation questions awaiting final settlement." Temporary settlements under which work has progressed have not in all cases been satisfactory to the parties and sometimes " so far as employers are concerned the work has not been carried out on an economic basis."

These are sombre observations, especially when it is recalled that union spokesmen have more than once asserted that the chief cause of demarcation disputes is the failure of the employers to consult the unions. At the Trades Union Congress last month, an undertaking was given that the T.U.C. general council would examine in detail the whole subject of unofficial strikes and relevant matters. An important " relevant matter " is surely this vexing one of demarcation disputes.

WATER SHORTAGE IN SOME AREAS

According to a statement issued in the last few days by the British Waterworks Association and published on page 362 of this issue, " the fact that the great majority of people of this country have been able to rely upon a normal water supply " during this very dry summer is " remarkable." The reason, it is suggested, is that " water authorities have been in a better position to meet a drought of this intensity than at any previous time in history." But, for our part, we feel that there is nothing to be so complacent about. For, though this summer may very well prove to be the driest ever recorded, dry summers recur in this country in what may be termed an irregular cycle of ten to eleven years or so. Furthermore, a dry summer is not infrequently followed by a relatively dry winter and then by another dry summer. It is surely to meet that standard rather than to stand up to a single dry summer that the water supplies of the country should be designed. Yet, in fact, a single dry summer has, in

some regions, already seriously depleted stored supplies—so much so that in a few of those areas (Tees side, for example) the threat is apparent that big industrial concerns may have to close down for lack of water. We cannot help feeling that in this country, blessed as it is by an average precipitation over the country as a whole fully ample to meet all needs for very many years to come (that is, unless agricultural irrigation develops rapidly, which might radically alter the picture, especially in eastern England), it is wrong that even a few areas should feel the pinch when a summer proves unusually dry. Additionally, it strikes us as strange that any area should find itself short of water and have to put up with restrictions upon its use when other areas not far away still have ample supplies.

Despite the fact that stored water supplies have run very low in certain places, we suspect that storage facilities as a whole in this country would have proved ample to provide plenty of water for everyone this autumn if arrangements for its distribution were not so faulty. We also suspect that schemes for extending storage facilities could be carried out much more economically than they are if there were better planning on national and regional rather than more or less parochial lines. The water supply situation seems now to be analogous to that which ruled for electricity supply before, between the wars, the Central Electricity Board was set up and the Grid constructed. In 1945 there were no less than 1250 separate and individual water undertakings in England and Wales. Since then the Minister of Housing and Local Government has actively encouraged amalgamation. But the number of individual undertakings still exceeds 900. It has been suggested, quite authoritatively, that about 100 supply units would be a suitable number, though, for our part, we would have thought even fewer would be desirable. It also seems to us desirable, if not indeed essential, that there should be some central body (analogous to the old C.E.B.) which should be responsible for constructing a water grid for supplying water to individual undertakings, for planning the construction of new intakes, storage reservoirs, &c., and making as sure as possible that there is neither competitive pumping from underground sources nor too heavy a draught upon them. According to a recent report of a sub-committee of the Central Advisory Water Committee, the country's rainfall is sufficient to ensure an adequate supply of water to meet the growing needs of the more distant future " provided that the proper means of conservation and distribution are developed." Was the sub-committee thinking, we wonder, along the same lines as ourselves ? For is it really possible to think that over 900 separate undertakings can arrange for the most economical means of collecting water, of storing water, and of distributing it evenly wherever it is needed ? Is it possible to suppose that even 100 could ? Now that large urban areas can no longer look to local resources, nor even, perhaps, to the whole watersheds in which they lie, to provide sufficient water and have, therefore, to look elsewhere, and when heavy demands for agricultural purposes are beginning to build up, it can be foreseen that a substantial fraction of the total precipitation must needs soon be used for water supply. It surely follows that, if, in future, there are to be ample and assured water supplies for the whole community without a deplorable loss to amenity through the depletion of water flows down rivers, the conditions in whole watersheds will need to be studied and arrangements made for water to be used over and over again before it reaches the sea. Planning can no longer remain parochial ; or be confined to areas. It must certainly become regional and as water will surely have to pass across regional boundaries, should it not become national ?

WRITE FOR DETAILS . . .

Many of our advertisers include the invitation " Write for details " in their advertisements. Others who do not do so, or whose products form the subjects of editorial articles, would nevertheless welcome inquiries. How many of our readers fail to respond because the wherewithal to reply is not at hand when they read an editorial description or an advertisement ? Secretaries are not ubiquitous and knots in handkerchiefs have been known to be neglected—or their reason forgotten. Was it put there to remind one of a luncheon appointment or more simply to bring home some coffee ?

In future, however, our readers will have no such excuse for not making an inquiry from a firm whose products are described in certain of our editorial pages or are the subject of an advertisement. If their interest is aroused all they need now do is to turn to the last page of each issue where they will find reply paid postcards waiting to be filled in and returned to us. By returning one of these cards readers can obtain further details not only from advertisers but also from firms whose products are described in our editorial pages, generally under " Shorter Reports." All that it is necessary to do is to enter the relevant reference number on the card.

There is of course a danger in introducing a service of this kind. Man is said to be an acquisitive animal and in some this acquisitive instinct is directed towards catalogue collecting ! We believe, however, that so far as our readers are concerned this danger is not a serious one, but we would particularly ask readers to remember that catalogues or brochures are generally expensive items and to confine their inquiries to those items in which they have a genuine interest. If this is done then our new reader inquiry service will perform a really useful function by bringing together what in legal phraseology may be termed " interested parties."

The first of these reader inquiry card insets is at your service on the last page of this issue.

The Engineer—100 Years Ago (SEPTEMBER 30, 1859)

" A New Aerial Ship "

" An experiment in scientific ballooning, greater than has yet been undertaken, is about to be tried in New York. The project of crossing the Atlantic Ocean with an air-ship, long talked of, but never accomplished, has taken a shape so definite that the apparatus is already prepared and the aeronaut ready to undertake his task. The aeronaut in charge is Mr. T. S. C. Lowe, who has made thirty-six balloon ascensions. The following are the dimensions of the balloon :—Greatest diameter, 130 ft.; transverse diameter, 104 ft.; height, from valve to boat, 350 ft.; weight, with outfit, 3½ tons ; lifting power (aggregate), 22½ tons ; capacity of gas envelope, 725,000 cubic feet.

" Its form is that of the usual perpendicular gas-receiver, with basket and life-boat attached. Mechanical power is to be applied ; the aeronautic party will keep the cold away from their marrow by the use of a lime-stove ; a new arrangement of revolving fans has been devised ; and the material of which the envelope is composed is covered with a peculiar varnish, the invention of Mr. Lowe. Dropping below the basket is a metallic life-boat, in which is placed an Ericsson engine. Its particular purpose is the control of a propeller upon the principle of the screw. The propeller is fixed in the bow of the life-boat, projecting at an angle of about 45 deg. From a wheel at the extremity twenty fans radiate. Each of these fans is 5 ft. in length, widening gradually from the point of contact with the screw to the extremity, where the width of each is 1½ ft. Mr. Lowe proposes to effect a landing in England or France, and will take a course north of east. A due easterly course would land him in Spain, but to that course he objects. He hopes to make the trip from New York to London in forty-eight hours, certainly in sixty-four hours. He scouts the idea of danger, goes about his preparations deliberately, and promises himself a good time."

London Spaceflight Meetings

NO hint of the imminent launching of " Lunik II " was given by the Russian delegates who attended the two meetings on space research organised by the British Interplanetary Society—the Commonwealth Spaceflight Symposium (August 27–29) and the Tenth Congress of the International Astronautical Federation (August 31–September 5). The papers presented by the Russians at the Congress were concerned only with the scientific results obtained in satellite and rocket experiments and did not deal with the engineering of the vehicles used for this work. This is no doubt the result of a decision taken by the political authorities, but there is hope that in the future Russia will participate more actively in the work of the I.A.F.

For several years Professor Leonid Sedov, the Chairman of the U.S.S.R. Academy of Sciences Commission on Astronautics, has been a Vice-President of the I.A.F., but has always declined to stand as a candidate for the Presidency. This year he agreed to allow the B.I.S. to nominate him, and was unanimously elected President by the I.A.F. Council—a tribute not only to Professor Sedov's ability but also to the feats his country has accomplished.

The Russians have undoubtedly come first in several of the preliminary heats in the " space race," but it can be argued that this is as much due to their concentration on a few well-chosen objectives as to their engineering abilities. The effort expended on space research in America may well exceed that of Russia (astronautics is now a major U.S. industry) but is spread over many more projects. Often two or more vehicles are developed for what is basically the same task. As with missiles, this may be the result of inter-service rivalry or of industrial competition.

A parallel with this situation could be seen in the attendance at the Congress. In contrast to the five Russians who participated (three from the Academy of Sciences, two from the London embassy), about half the 650 delegates came from the U.S.A.—mostly as official delegates from industrial companies, military establishments and other government agencies, the universities and various research organisations. Of the eighty-odd technical papers read, American contributions were the most numerous.

N.A.S.A. Work

The inaugural paper on " Global Aspects of the Exploration of Space " by Dr. Dryden (printed in THE ENGINEER, September 4) included a general survey of the astronautical programme of the National Aeronautics and Space Administration. In his paper, Dr. Dryden mentioned that two new developments had been started—(1) a cluster of existing engines to give an early capability of about 1,250,000 lb thrust, and (2) a new single-chamber rocket of 1,000,000 lb to 1,500,000 lb thrust, which can be clustered to give 6,000,000 lb thrust or more.

These future projects are known respectively as " Saturn " and " Nova." " Saturn " was initiated by von Braun's group at the U.S. Army Ballistic Missile Agency and will use H-1 engines developed by the Rocketdyne Division of North American Aviation. The engines for " Nova " are now being developed by Rocketdyne for N.A.S.A., and more information about the vehicle was given by M. W. Rosen and F. C. Schwenk.

Although it could be used for work in satellite orbits or cis-lunar space, the main purpose in designing " Nova " is to provide a vehicle powerful enough for manned *direct* flight to the Moon. The payload reaching the Moon must therefore be equipped with rocket engines to ensure a soft landing and return to the Earth. As at present envisaged, " Nova " is a five-stage vehicle, with the mass breakdown given in Table I.

TABLE I—*Mass Breakdown for " Nova "*

Stage 1 : Masses	
Launch, lb	6,700,000
Burn-out, lb	2,000,000
Stage, lb	5,000,000
Stage 2 : Masses	
Gross lb	1,700,000
Burn-out, lb	678,000
Stage, lb	1,100,000
Stage 3 : Masses	
Gross, lb	600,000
Burn-out, lb	146,000
Stage, lb	498,000
Stage 4 : Masses (landing rocket)	
Gross, lb	102,000
Burnt-out (on Moon), lb	49,100
Propulsion, tanks, landing gear lb	13,100
Payload on Moon, lb	36,000
Stage 5 : Masses (return rocket)	
Gross, lb	36,000
Burn-out, lb	13,700
Propulsion and tanks, lb	3,800
Mass returned to Earth, lb	8,000

The vehicle stands about 220ft high and the first stage is 48ft in diameter. The conical portion at the top contains the landing or fourth stage, the take-off or fifth stage, and the manned capsule or payload. Upon return to the Earth, the payload will weigh 8000 lb, including crew (two or three men), equipment, capsule, guidance and control, and parachute.

Six engines each of 1,500,000 lb thrust power the first stage, the propellants (liquid oxygen and kerosene) being carried in a cluster of seven tanks, each 16ft in diameter. The second stage is propelled by a single 1,500,000 lb engine, modified for high-altitude operation, and uses a cluster of four 16ft diameter tanks.

Another cluster of four 16ft tanks is used for the third stage, together with four engines each of 150,000 lb thrust. This stage would operate on high-energy propellants, probably liquid hydrogen and liquid oxygen.

The fourth or landing stage also utilises these propellants, and four throttleable engines provide the required variations of thrust for the landing manœuvre. Approximately one minute's hovering time is provided, to allow the pilot to make the final choice of landing point. Retracted landing legs terminating in platelike feet are on the side of the fourth stage ; when extended for landing they span a distance of 40ft, for purposes of stability on what may be a very uneven surface.

The fifth stage is placed in a cylindrical tube that pierces the tankage of the landing stage ; at take-off from the Moon, it slides out on rollers. This arrangement was chosen to ensure a low centre of gravity and reduce any tendency to topple. The manned capsule is an enlarged version of the one to be used in Project " Mercury " (the manned Earth satellite). It is a truncated cone, with a maximum diameter of 12ft and a height of 14ft, and has two levels inside. The lower contains couches for the crew, controls, communications, and a folding airlock ; the upper contains food, power supply, exploration gear and work space. The outer surface of the capsule is covered with an ablative material for insulation against and removal of heat generated during atmospheric re-entry.

The initial guidance phase from launch to Earth-escape can be accomplished with sufficient accuracy by inertial systems. Mid-course guidance by means of Earth-based radio could direct the vehicles to an accuracy of 50 miles for a lunar impact trajectory. The terminal phase—final approach to the Moon and lunar landing—would employ vehicle-contained guidance with the assistance of radio beacons already established on the Moon near the proposed landing area.

Launching from the lunar surface would be guided by an inertial system aligned and calibrated by the pilot on optical sightings of stars and Earth. The proper re-entry corridor in the Earth's atmosphere would be reached by a combination of optical sightings and Earth-based radio signals. After the initial slow-down to orbital speeds, Earth-based radar would control the vehicle.

Before the manned voyage was undertaken, an unmanned " Nova " would be sent to the lunar landing area. This would not only be a test for the vehicle ; it would also provide the first explorers with a spare return vehicle. At the moment, it is not yet certain whether cryogenic propellants, such as liquid oxygen and hydrogen, can be stored under the lunar conditions (even for the twelve days which the first party would spend on the Moon), and so the high-energy propellants for the fifth stage would probably be of a type liquid at normal temperatures and pressures (e.g. hydrazines and nitrogen tetroxide). This is a matter for further consideration.

" Nova " represents one attitude to the problem of manned flight to the Moon ; " Saturn " another. Although no paper on " Saturn " was presented at the Congress, some information on the vehicle is available. It is considerably smaller than " Nova," but the A.B.M.A. regard it as " the work-horse of space." As it is built up from available components, it should not require a long time to reach operational status. A quarter-scale mock-up of the booster was prepared some months ago. Static tests of the full-size clustered motor will take place in December, and the first flying tests towards the end of next year. The completed space vehicle, with a Martin Company " Titan " as second stage, and a Pratt and Whitney liquid hydrogen engine as third stage, could be ready in about two and a half years.

The eight " H-1 " first-stage engines are improved versions of that used in the " Jupiter " and " Thor " missiles. Each engine will operate independently, with its own turbo-pump and gas generator, but the tankage will be common.

A.B.M.A. envisage these vehicles being used for orbital techniques—a term employed by the astronaut for such operations as refuelling or construction of space stations in satellite orbits. Several manned " Saturns" could be used to assemble and fuel the lunar vehicle in space. Hundreds of " Saturns " are likely to be built for this and similar operations.

A list of pros and cons can be drawn up for both the direct flight and orbital rendezvous methods of achieving manned flight to the Moon. There is no clear-cut superiority of one over the other at the present stage of astronautics, and each method has its supporters among rocket engineers. Mr. Rosen was naturally strongly in favour of the direct-flight approach, but many attending the Congress think the orbital method more likely to succeed. The urge to surpass Russian achievements, coupled with the ready availability of the " Saturn " booster, would appear to indicate that the latter view may prevail, but it must be remembered that

it will be some time before experience has been gained in orbital techniques—man has yet to arrange for two satellites to rendezvous in orbit, and that may prove a more difficult task than a hard landing on the Moon.

Re-Entry Into Atmospheres

One of the subjects receiving great attention is re-entry into planetary atmospheres—of interest in connection with both missiles and space vehicles.

Mr. Dean R. Chapman, of N.A.S.A., has made a mathematical analysis of the accuracy necessary for interplanetary space craft to be guided into the entry corridor of the target planet. Within this corridor, atmospheric drag causes sufficient deceleration for entry to be completed, yet the deceleration is not excessive for the human occupants. Mr. Chapman considered the general case and defined the characteristics of the corridor in terms of those of the vehicle and the planet. A dimensionless parameter coupling certain aerodynamic characteristics of the vehicle with planetary characteristics evaluated at the perigee altitude of the approach conic trajectory (the perigee if no atmosphere were present) is used to bridge the two-body orbit equations to the re-entry motion equations.

The vehicle mass, size and drag coefficient strongly influence the altitude of the entry corridor, but its width is independent of them. Illustrative calculations have shown that the corridor width for vehicles with aerodynamic lift is much greater than that for non-lifting vehicles in the case of the atmospheres of Earth, Venus and Jupiter, but not so with Mars or Titan. The guidance requirements for entry into the Martian corridor are considerably less severe than those for hitting the Moon from Earth—already accomplished by "Lunik II." Entry into the corridors of Earth or Venus is more difficult, being a somewhat less severe task than landing an I.C.B.M. within 1/5000th of the range.

The kinetic energy lost by a space vehicle or missile during re-entry is converted into heat. Some of this is carried away by the tenuous gas through which the body passes, but the forward parts of the body become heated. This heat can be dissipated either by radiation or by ablation—thermal erosion and disintegration of the body by fusion, vaporisation, &c. S. M. Scala, of the U.S. General Electric Company, has studied the type of behaviour one may anticipate during hypersonic flight from four different classes of ablating materials—quartz-like refractory vaporising oxide, graphite-like refractory, reinforced plastic, and thermoplastic resin. Analysis indicated that there was probably no single best ablating material; the selection depended on the type of application intended. Graphite would yield the most stable shape during hypersonic re-entry, but unless it was backed up by a lightweight thermal insulator the payload would be reduced.

W. R. Warren (of the same company) reported some laboratory experiments on re-entry aerothermodynamics. In addition to air arc ablation tests on various materials, he described shock tunnel investigations and outlined future developments. It is also possible to study the physical processes taking place during actual re-entry of a missile; this has been done by D. D. Woodbridge and W. N. Armquist, of A.B.M.A. They studied the radiation emitted by the booster of a "Jupiter" rocket as it returned to Earth. Characteristic spectrographic lines, such as those from aluminium oxide and sodium, and the strong atmospheric absorption due to water vapour, were observed. The best results were obtained with instruments located on ships near the impact area, but preliminary work was done from an aeroplane and a desert island. The programme (which is termed "Operation Gaslight") is to be continued.

The manned satellite designs most frequently proposed are extrapolations either of missile nose cones or of aircraft. A group at A.V.C.O. Corp., Everett, Mass. (R. W. Detra, A. R. Kantrowitz, F. R. Riddell and P. H. Rose), presented a new approach in which controlled re-entry would be accomplished by use of a variable-area drag brake. This is an umbrella-like structure attached to a central, nearly spherical pressure vessel acting as the cabin. The skin of the umbrella consists of fine wire mesh overlaid with strips of stainless steel overlapping each other like shingles on a roof. The skin loads are carried down to the capsule by a system of ribs and arms; twenty-four pneumatic actuators are provided for opening the brake (it will operate satisfactorily if only a small number of these are used). Propellant charges are provided for emergency one-shot opening.

The human passenger would enter the capsule through a central hatch at the top, while the drag brake is in the open position on its preflight stand. After securing the hatch, the drag brake would be folded into the launch configuration with the ribs vertical around the capsule and the skin folded inboard between the ribs. A nose cover protects the folded ribs and skin from the high dynamic pressures during launch. The entire vehicle is mounted on to the booster with a short transition section. The drag brake could be tested in full scale on the ground; an existing facility large enough for this job is the "Turbo-cat" of the All-American Engineering Company. Among the advantages claimed for the drag brake over retro-rockets are better reliability and savings in weight.

Dr. W. F. Hilton, of Hawker Siddeley Aviation, has drawn up tables for the retro-rocket braking required at apogee to decrease the perigee height of a satellite by a fixed amount. In connection with the design study for a manned re-entry vehicle presented by Mr. H. R. Watson at the Commonwealth Spaceflight Symposium, Dr. Hilton has compared the advantages of lifting and non-lifting vehicles. The "drag plus lift" vehicle decelerates more slowly, so that the stresses are less and the heat input is spread over a longer period, enabling radiation to occur.

Propulsion Systems

Several papers dealt with advanced propulsion systems, including nuclear, ion and photon rockets. Professor G. Leitmann, of the University of California, dealt with the performance optimisation of nuclear rockets. His analysis showed that the optimum exhaust speed programme was independent of the mass flow rate and that the characteristic speed resulting from this programme depended only on the total mass of the working fluid and increased with it.

J. J. Newgard and M. M. Levoy (Reaction Motors Division, Thiokol Chemical Corp.) analysed the power plant requirements for a number of missions, including single-stage, large payload, nuclear-boosted escape vehicles; chemically boosted, second-stage nuclear rockets escaping with large payloads; and terrestrial orbiting nuclear vehicles capable of moving into far space (e.g. for orbiting Mars). Missions of this type could be accomplished with a family of hydrogen cooled, solid-fuel, graphite-moderated, beryllia reflector moderated reactor power plants varying in mass between 14,000 lb and over 160,000 lb. The members of the family would be similar in construction and control. The principal problems in the heavier systems will arise from the high internal drag and acceleration forces at high power output and from the large-scale perturbations which can be expected. These systems could be developed with our present technology. Experimental nuclear rocket engines have already been constructed in U.S.A. and work has also been proceeding on another advanced type of engine—the ion rocket. This is intended to function only in space, and has been likened to a large cathode-ray tube with the front removed so that the ions can escape; the propulsive force is the reaction on the "tube" produced during their emission and acceleration. R. H. Boden (Rocketdyne Division of North American Aviation) reported developments in ion rockets during the past two years. Experiments in high-vacuum environments had been made with an ion thrust chamber, using electrostatic acceleration of ions generated from surface contact ion sources. Preliminary evaluation of the results of this programme indicated that a flyable prototype engine could be produced within a few years. Information on ion sources for such an engine was presented by G. Kusevics, of the U.S. General Electric Company. He analysed the energy losses and calculated the surface ionisation efficiencies for all alkali metals on tungsten and for caesium on various base metals, assuming no adsorption. His paper included a useful bibliography (250 references) on surface ionisation.

Instead of using surface ionisation, an ionised gas (plasma) may be used for propulsion. R. W. Waniek (Giannini Plasmadyne Corp.) reviewed theoretical problems and some present-day results obtained in accelerating plasma by the action of strong, transient, magnetic fields. R. X. Meyer (Space Technology Laboratories, Inc.) dealt with the underlying principles in his paper, "Magnetohydrodynamics and Its Application to Propulsion and Re-Entry."

J. Ulam proposed two new types of electric propulsion device. The first was virtually an electrothermic plasma motor, vapour produced in an electric arc (by vaporisation of either the electrode material or a liquid supplied to the electrode spot) being converted into a high-velocity jet. The second is an electric explosion motor, in which a conducting liquid between two electrodes is vaporised by a high current impulse, the superheated vapour being ejected at a high velocity (and possibly further accelerated by the action of a transverse magnetic field). The process would be intermittent, like that in a pulse-jet engine. An even more visionary method of propulsion employs light (photons) instead of ions. Eugen Sänger, Director of the Forschungsinstitut für Physik der Strahlantriebe e.V., Stuttgart, dealt with the direction of intense beams of photons by electron gas mirrors. According to his calculations, the radiation intensities of 10^9 cal $cm^{-2}sec^{-1}$ required for photon propulsive jets or weapon beams could be obtained from black radiation of heavy plasmas at 150,000 deg. K. The radiation could be focused only by reflectors with electron densities of 10^{27} cm^{-3} accomplishable by heavy compression shocks of the plasma itself, or better of pure electron gas.

To return to more conventional rockets, a survey of the applications of solid propellents in spaceflight has been made by H. L. Thackwell, Jnr. (Senior Vice-President, Grand Central Rocket Company). He also suggested an all-solid design as an alternative

for the "Scout," the four-stage rocket which America is to make available to other countries to launch instruments into satellite orbits. The proposed vehicle, named "Envoy," would be 37·8ft high, weigh 17,000 lb and be capable of placing a 230 lb payload in a 300-mile orbit or sending a 50 lb payload to the Moon.

Space Biology

In preparing for the first manned orbital flight, crew reliability must be considered as important as the reliability of the vehicle itself. The problems of personnel selection and training for spaceflight were explained by Brigadier-General Don Flickinger, U.S.A.F. N.A.S.A. procedure is to recruit all candidate-volunteers from service pilots who have graduated from experimental test pilot schools. They are examined in respect of their physical and mental fitness and their stamina and durability under simulated stresses of spaceflight. Having passed these tests successfully, they proceed to a comprehensive education and indoctrination programme. This covers training in such points as knowledge of the design and engineering principles of the space vehicle, the observational and control techniques necessary during all phases of flight (including work with mission task simulators), orbital hygiene, survival techniques suitable for any region of the world, and academic education (in orbital dynamics, astrophysics, space biomedicine, meteorology and geography). The use of flight simulators and balloon-borne systems for predicting man's performance in space was covered by J. G. Vaeth, while a relatively simple apparatus for simulating the experience of flying a rocket in interplanetary space was demonstrated by C. A. Cross.

Power Supplies

One of the problems in spaceflight is that of providing a reliable source of electrical power for auxiliary systems. The only two systems developed to date which provide a long-lived source of electricity from a lightweight package are solar cells and isotopic power. Dr. W. W. T. Crane of the Martin Company's Nuclear Division dealt with isotopic power—the heat generated in a sealed quantity of radio-isotopes and surrounding containment material is partially converted into electricity (e.g., by thermo-elements) and the remainder dissipated externally. Two major types of radioactive materials may be used—waste from the controlled fission of uranium, or alpha-emitting isotopes produced by irradiation of suitable target materials. The latter have advantages for use in space research, and of the possible isotopes four are considered the most suitable : curium-242 and polonium 210 as short-life, high-power sources, plutonium-238 as a long-life source, and curium-244 for intermediate periods. SNAP-III, a power source containing polonium-210 with twenty-seven radially placed couples of lead telluride elements (each couple contains one N-type and one P-type element, doped with bismuth and sodium respectively) weighs 4 lb, but is equivalent to 160 lb zinc-silver cells. The hot and cold junction temperatures are 496 deg. and 107 deg. Cent. respectively and the electrical output 3·3W. The efficiency is only 5 per cent or 6 per cent, but it is expected that improvements can be made.

Studies in the U.S. General Electric Company's Flight Propulsion Laboratory made by M. A. Zipkin and E. Schnetzer have concerned turbo-generator space power systems. A Rankine cycle system in which alkali metal vapour was used as the working fluid was found more suitable for space environments than a Brayton cycle system (inert gas as working fluid). In both systems waste heat is rejected to space by radiating surfaces. A preliminary design of a 1MW system with potassium as a working fluid for a four-stage molybdenum turbo-generator is given. The system has overall dimensions of 12ft diameter, 70ft length, the radiator being the largest component (effective area 2000 square feet). The total mass is 13,000 lb.

COMMONWEALTH SYMPOSIUM PAPERS

Reference has already been made (see The Engineer, September 4) to the three more important papers presented at the Commonwealth Spaceflight Symposium. Two of these originated in the Hawker Siddeley Group, and concerned a hypersonic ramjet and a recoverable orbital vehicle. The third paper dealt with the use of the de Havilland "Blue Streak" L.R.B.M. as a booster for an orbital vehicle, and was presented by Mr. G. K. C. Pardoe, Chief Co-ordinator of the "Blue Streak" project. The photograph already published showed the more advanced of three preliminary designs, a modified "Black Knight" rocket being used as the second stage. In the second design, a substantially unaltered "Black Knight" was employed ; this two-stage vehicle would be quite capable of carrying 1000 lb payload to the desired satellite circular orbit at 300 miles altitude, but is less desirable structurally. A 1000 lb payload at the end of the long thin body of "Black Knight" would introduce considerable bending stresses at the junction of the two stages. Moreover, the additional height would mean that the servicing towers already in use for "Blue Streak" could not be employed (as would be possible with the more compact "doughnut" second stage).

Mr. Pardoe's simplest design could be ready at an early stage : the second stage is a "cluster" of two existing solid rocket motors concealed under a light fairing. The suggested satellite consists of two connected canisters indexed with the twin motors for compactness. The gross weight of the spin-stabilised second stage would be 8000 lb and it should be capable of placing a 1000 lb satellite in a circular orbit at an altitude of 300 miles. However, the shape of the satellite would place limitations on the type of instruments which could be carried, but this design has the advantage that a comparatively cheap all-British satellite programme could be brought into being in a matter of months—the testing and launching facilities for "Blue Streak" at Woomera are now being constructed.

Although intended mainly for tests on missiles, the facilities of Woomera have already been used firing "Skylark" research rockets in connection with the I.G.Y. In his paper "Solid Propellant Rockets for High Altitude Sounding and Their Economics," W. T. Fisher (Bristol Aerojet, Ltd.) said that although sounding rocket design was rather an art at present, work with rockets such as "Skylark" had shown that their flight path was very predictable. It should be possible to produce economical small rockets for routine meteorological purposes—efficient unguided designs with two or more stages fired from reasonably cheap launchers.

Nuclear rocket engines were discussed by O. H. Wyatt of Hawker Siddeley Nuclear Power Company, Ltd. He calculated the probable performance of thermal fission rockets using uranium-235 or plutonium-239 as fuels, with graphite as moderator, and hydrogen or ammonia as working fluid. The all-up weights were in the range 2·5 by 10^5 lb to 3 by 10^6 lb, and the corresponding thrusts 6·3 by 10^5 lb to 6·6 by 10^6 lb. D. S. Carton's paper "Minimum Propulsion for Soft Moon Landing of Instruments" included scaling rules he had derived to permit assessment of the relative merits of tank pressurisation or turbo-pumps, selection of optimum tank and combustion pressures, expansion ratios, &c. Scaling ratios are given for one solid and six liquid propellants. The other papers at the symposium were concerned with Australian and Canadian facilities, satellite tracking, cabin conditioning, space navigation, re-entry and recovery and the economics of spaceflight.

The Symposium concluded with an afternoon's discussion. The important point brought out is the keenness of British industry to see a British spaceflight programme instituted, even if initially on a small scale. It is true that the Government has approved a limited satellite programme in which British instruments will be ferried aloft by the U.S. "Scout" vehicle (to be available in about two years' time). The possibility of British vehicles is still being considered, but the Government's advisers on space research are mostly scientists rather than engineers and therefore tend to be more interested in the instrumentation than the vehicles.

As the country can only afford a limited sum for space research, expenditure on vehicles must mean less money available for instrumentation, which prejudices some scientists against the idea of a British satellite. But, apart from questions of national prestige or the desirability of utilising the spare capacity of the aircraft industry, can Great Britain afford to stand aside from this new technology and the special techniques, skills and knowledge which it involves? In the past Britain has always participated in major new developments—such as steam propulsion, the internal combustion engine, aeronautics, radio, &c.

Of course, astronautics offers such vast possibilities that it is not surprising that the real decision on the establishment of a British programme has been left until after the General Election. The matter has not yet become a point of issue between the parties, but it is interesting to note that the present Minister of Supply (Mr. Aubrey Jones) is in favour of the programme. In opening the I.A.F. Congress he rebuked British scientists who still looked askance at space research, saying that he was not impressed by the arguments against it that they advanced. "Scientifically there was surely no doubt at all but that every state which claimed to bear the banner of civilisation should do everything it could to encourage advances in the knowledge of the physics, chemistry and even the biology of space."

Colour Identification of Pipelines.—A range of self-adhesive coloured tapes for pipeline identification being supplied by John Gosheron and Co., Ltd., Albert Embankment, Vauxhall, London, S.E.11, is designed to conform to B.S.1710, covering both basic colour identification of pipelines and detailed identification. Where it is necessary to identify the actual contents of the pipeline, this can be achieved by using a tape printed with the appropriate words or symbols. Direction of the flow of fluids can also be indicated by using tape printed with arrows from 3in to 6in long. A 2in wide tape in 36-yard rolls is usually supplied with ¾in lettering and approximately ¼in intervals between texts. This "Two-Ply" pipe tape consists of printed cellulose tape laminated with either ethyl cellulose or thin vinyl tape, according to the specified installation requirements.

"Hoister" Equipment for Tanker Offshore Loading

The first "Hoister" equipment developed for offshore loading of large tankers at buoy berths was put into service in January, 1959, at Mina-al-Ahmadi. In this article we deal with the development of this system devised by Mr. A. C. Hartley, and give some notes on the first installation.

BRIEF mention has been made in our columns of the "Hoister" equipment developed by Mr. A. C. Hartley to facilitate the offshore loading and unloading of large oil tankers at buoy berths. We have now received full details of this equipment and particulars of the port installation of the Kuwait Oil Company, Ltd., at Mina-al-Ahmadi, which can be seen in the accompanying illustrations and drawing.

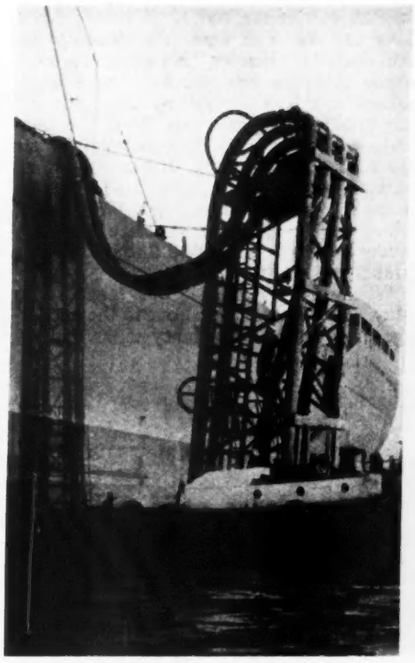
Buoy berths for tanker loading purposes are, of course, not new, but hitherto the rate of loading at such berths has been limited by the high friction drop in the long lengths of flexible loading hose that are required to connect a submarine pipeline to a tanker's manifold whilst, at the same time, allowing the tanker freedom of movement in its berth. The number of lines of hose that can conveniently and safely be used without risk of damage by entanglement or kinking is usually limited to two or, at most, three. The diameter of the hoses is also limited by the capacity of a tanker's gear to lift the heavy submarine type of hose used which must be strongly reinforced to withstand wear and tear on the sea bed.

The principle upon which the "Hoister" is based is to lift the connecting hose from the sea bed by providing a buoyancy means. To achieve this, about two-thirds of the length of a flexible hose which normally has to be raised is replaced by rigid steel pipe to which are connected buoyancy tanks, which, when emptied of water by compressed air, lift one end of the pipe to a convenient deck level, the other end of the pipe being anchored to the sea bed by chains. In this position, the upper and lower parts of the hose act as flexible connections between the sea line and the "Hoister" pipes at the bottom and between the "Hoister" and the tanker at the top. The required number and diameter of steel pipes are braced together to form a jib-like structure and the chain anchorage of this structure is designed to form a pivot which allows the top of the "Hoister" freedom, when pulled by the hoses coupled to the tanker, to follow the movements of the ship at its moorings.

The position of the centre of buoyancy of the structure is arranged so that the "Hoister" comes to rest after passing through an angle of about 70 deg. from the sea bed when the buoyancy tanks are fully blown. The buoyancy tanks are so designed that they are always below the troughs of the waves and their capacity is sufficient to ensure a substantial upward pull on the anchor chains at all times, thus ensuring that the "Hoister" is not influenced by wave action. A progressively increasing force is required to rotate the "Hoister" further towards the tanker, thus ensuring that the top hoses are pulled into a smooth catenary curve when they are coupled up and that even if they have to be released in emergency, when fully extended by the movement of the tanker to its extreme distance, the "Hoister" will be rotated away from the ship towards its position of rest. When not in use and submerged the structure lies flat on the sea bed, where it offers no obstruction to shipping and is unaffected by storms.

Mr. A. C. Hartley's company, Clifford Hartley Patents, Ltd., entrusted the preparation of preliminary designs to the consulting engineers, Rendel, Palmer and Tritton, and Mr. R. J. Ashby, of the Imperial College of Science and Technology made models for testing purposes. As a result of successful tests on these models Constructors John Brown, Ltd., with Mr. J. W. Burrell as consulting engineer, prepared detailed designs for an installation to meet the requirements for loading a 65,000 tons deadweight tanker in 65ft of water at L.W.O.S.T. From these designs, John Brown (Clydebank), Ltd., constructed a model of ¼in to the foot and carried out a series of tests.

Following a review of these tests the Kuwait Oil Company, Ltd., decided, in July, 1957, to have designs prepared for a prototype "Hoister" and to install it at the "J" berth at Mina-al-Ahmadi, to load tankers of up to 65,000 tons, anchored in 55ft of water at L.W.O.S.T., where there is a rise in tide of 11ft.



"Hoister" raised by buoyancy tanks and with two of the crude oil hoses passed over bulwarks of vessel ready for coupling

The submarine lines at this berth are one of 24in diameter for crude oil and one of 12in for bunker fuel. It was calculated that if the "Hoister" were equipped with three 10in diameter hoses for crude oil and with one of 8in for bunker fuel, approximately the full free flow of the loading system as a whole would be obtained. It was decided, however, that the bottom hoses and the steel pipes forming the "Hoister" should all be of 12in diameter so that if additional capacity were required in the future, this could be obtained by installing an additional sea line and only changing the three top crude oil hoses from 10in to 12in diameter.

It was also decided to use a portable diesel-driven air compressor on a launch to supply the compressed air required for blowing the buoyancy tanks, the air being delivered through a flexible hose, the free end of which would normally lie on the sea bed chained to a small buoy for convenience in picking up. In future installations, air through a steel air line laid alongside the oil line, and a short length of hose will be supplied from the shore alongside the oil hoses. The design was prepared to provide for a tanker to have a minimum freedom of movement of 40ft in any direction from its mean position.

An anchorage for the "Hoister," which was designed by Rendel, Palmer and Tritton consists of six 14in by 14in "H" section piles which were driven through a template into the sea bed at the site and fitted with caps for shackling to the anchor chains.

"Hoister" being towed out to anchorage site

These piles, arranged in groups of three, provide two pivotal points 10ft apart and 6ft above the sea bed for the bottom connection of the " Hoister." A manifold with three 12in diameter connections was fitted to the 24in submarine crude oil line and one 12in diameter connection to the 12in submarine bunker fuel line These four connections were lined up to face the four 12in connections at the bottom of the " Hoister " when anchored and lying in its position on the sea bed.

As can be seen from the drawing we reproduce the " Hoister " is a straightforward braced structure with the four main longitudinal members formed by the crude oil and bunker fuel pipes. Its three buoyancy tanks are connected by a compressed air manifold and when the structure is in its vertical position their tops are some 4ft below the surface at low water. When these tanks are flooded the structure naturally pivots over to be supported through rubbing strakes on the sea bed.

When the " Hoister " was launched in May, 1958, it was floated out to the anchorage using its own buoyancy tanks and the assistance of a " camel " which was used to support the heavier upper end. This towing operation can be seen in one of our illustrations, and when the structure reached its anchorage the lower end was pulled down and shackled by previously fitted chains to the pile caps.

Preliminary trials with a 16,000-ton tanker showed that the usual practice of supplying an extra 20ft length of hose to the tanker and using a steel elbow for connecting up at the bulwarks to the sea hose caused considerable delays and was unnecessary with the " Hoister." Experiments carried out on shore to develop more suitable methods showed that the 60ft lengths of hose at the top of the " Hoister " could be connected directly to the tanker's manifold on deck instead of to the steel elbows, outboard of the tanker's bulwarks, and that handling would be facilitated by an arrangement of yokes at the 40ft and the 60ft joints.

When a routine loading was carried out in January this year with the tanker " British Courage " the " Hoister " was rigged with three 10in diameter cargo hoses 60ft long, each made up of three 20ft lengths joined together by flanges, and with one similar length of bunker hose of 8in diameter. The hoses were coupled together in pairs by detachable yokes at the flange joints 40ft and 60ft from the top of the " Hoister." The yokes at the 40ft joints on each pair of hoses were linked to the yokes at the 60ft joints by shackling wire lines fitted with fleeting rings between them. The ends of these wire lines at the 40ft yokes were readily accessible at sea level and when unshackled provided a means for connecting a line from the tanker's derrick for pulling up the ends of each pair of hoses. The ends of each pair of hoses were then fleeted up above deck level so that the 40ft yokes could be pulled in towards the side of the tanker and secured to take the pull of the " Hoister " and the weight of the hoses at the correct distance from the ship's manifold to allow the 60ft flanges of the hoses to be lowered down and presented to the tanker's manifold one at a time after the yokes at the 60ft flanges had been removed.

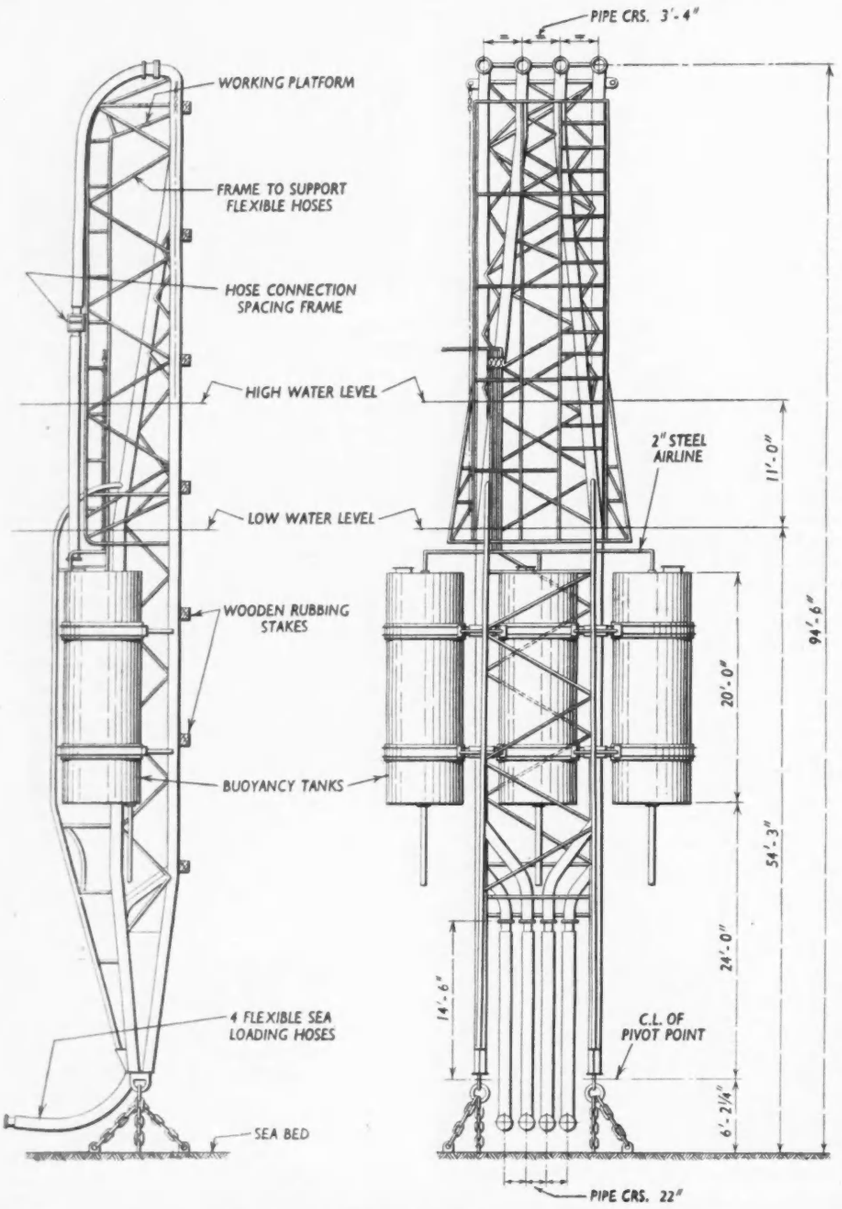
It was found that the weight and pull of the hoses automatically controlled the position of the " Hoister " thus eliminating the need for breasting ropes and reducing the time required for coupling and uncoupling the hoses.

At the time of the first loading operation, owing to the requirements of other tankers, the oil stock position and the maximum loading rate of 3000 tons an hour requested by the " British Courage," it was arranged that only one gravity line should be used for most of the loading time. In order to determine the maximum loading rate possible through the equipment however it was arranged that a second gravity line should be available for a period of four hours.

Arrangements were also made for recording the pressures during the loading operations at a sufficient number of points, including the tanker's manifold, to provide data for calculating the maximum loading rate available. This was found to have been at the rate of 3530 tons an hour, compared with the rate of 2640 tons an hour which would have been available under precisely similar conditions with the normal method used at the berth. The " Hoister " therefore provided an increase in the normal rate of 890 tons an hour or 33 per cent. The oil lines were vented from the shore in the normal manner and the flanges were disconnected in the usual manner.

Experience has shown that the limiting wind and sea conditions under which a " Hoister " can safely be used depends largely upon the extent to which the method of mooring a tanker can be relied upon to keep its movement within the designed limits of 40ft radius from its mean position. A crash diving method is now being developed for returning the " Hoister " quickly to the sea bed in case of emergency. The length of flexible hose now used for each line with the standard method of loading is 220ft to 240ft and this is reduced by the use of the " Hoister " to 80ft. There is therefore a reduction of almost two-thirds in the amount of hose required resulting in a proportional reduction in first cost and probably much more in maintenance because the " Hoister " keeps the hoses out of contact with the sea bed and with each other thus avoiding any risk of entanglement, kinking, or other hazard.

In connection with this equipment we are informed that world-wide patents have been granted to Clifford Hartley Patents, Ltd., which has arranged for the Collins Construction Company of the United States to undertake with it the further development, sales, design and installation of the " Hoister."



General arrangement of " Hoister " installation

The Dutch Delta Plan

PROGRESS WITH A TWENTY-FIVE YEAR SEA DEFENCE PROGRAMME

Proposals for protecting the islands of South-Western Holland from storm surges and from increasing ground-water salinity are on a vast scale, and involve the construction of dams in the open sea in depths and against tidal currents greater than has been attempted before. One of the principal structures of the plan has been built, and five are at present under construction; it is planned that the entire programme will be completed in 1978 at an estimated cost in the region of £200 million. The first article describes the proposals generally; three specific structures are described in subsequent articles.

THE deltaic region of South-Western Holland, where the various branches of the Rhine and also the rivers Maas and Schelde debouch into the North Sea, has always been vulnerable to damage from heavy seas and tidal flooding. The various islands and peninsulars of the region were reclaimed centuries ago, but the conservation of the reclaimed land is becoming increasingly difficult as time passes. The dual phenomena of (*a*) rising sea level, and (*b*) subsidence of the land surface, although very slight (together 15cm to 30cm per century), have an appreciable bearing on drainage when considering a span of several centuries. Furthermore, as drainage becomes more onerous, so salinity of the soil increases. Taking, for instance, the island of Schouwen-Duiveland, at the time of its reclamation, natural drainage needed assistance from windmills only for short periods at high tides when conditions otherwise were unfavourable; now a part of the island must be drained by pumping, the pumps operating at practically all states of the tide.

But the greatest and most immediate cause of insecurity is that of direct flooding from the sea, particularly at times of tidal surge or "storm surge" as it is sometimes called. Schouwen-Duiveland suffered heavily from the great storm surge of 1953; apart from direct flood damage, poisoning of the land by the salt water which flooded the island for several months at that time took years to overcome.

By contrast the lands lying behind the shelter of the enclosing dam of the Zuiderzee enjoy the benefit of virtually certain protection against storm surges, and also have no problem of increasing salinity of the soil, since the Ijssel lake contains fresh water.

The success of the Zuiderzee scheme and the disaster of 1953 have been the incentives which stirred the Dutch public conscience sufficiently for a start to be made about five years ago on the construction of that vast sea defence scheme which is known as the delta plan. It was evolved in principle and discussed before 1953. But it needed the tragic events of that year to assure public support for such a large and financially onerous scheme, just as the disaster of 1916 is considered to have been a critical factor in actually starting work on the Zuiderzee scheme. Needless to say, the reaction against the expense of an imaginative scheme of this nature frequently proves unjustified, and many advantages accrue, some of which cannot be entered in a balance sheet; and so it is expected that the delta plan will prove a profitable investment and will, in fact, be a fundamental gain in the economy of South-Western Holland. This will be clear from the ensuing description of the scheme, and of what it is intended to achieve.* It will also be apparent that, from

* Previous articles relating to reclamation works in Holland, and which have a bearing on the matters discussed in our introduction are: "Sea Defence in Holland" (an article reviewing the repair work needed after the 1953 storm surge), published in a supplement with THE ENGINEER of June 11, 1954, and "The Zuider Zee Reclamation," THE ENGINEER, June 28, and July 12, 1957. An account of the weather conditions which may give rise to a tidal surge in the North Sea was given in THE ENGINEER of December 4, 1953. The situation in this country immediately after the 1953 storm surge was discussed in a leading article in THE ENGINEER of February 13, 1953.

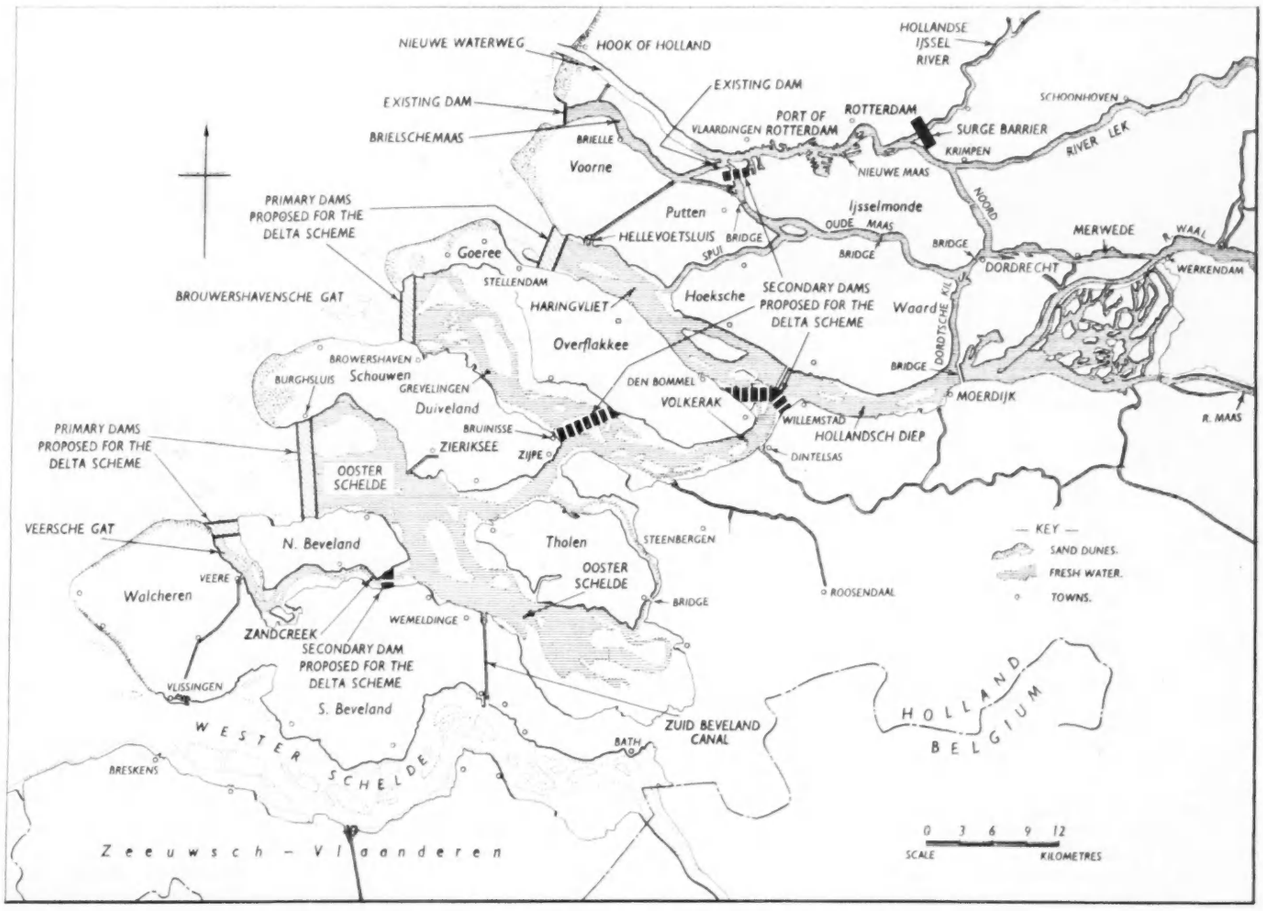


Fig. 1—The delta plan proposals in South-Western Holland. The complete scheme will shorten the shoreline by 435 miles

Fig. 2—Hellegat dam ; progress last May. This dam comprises the Western arm of the secondary dam called Volkerak in Fig. 1. The Volkerak is, in fact, the deep channel shown in the foreground

the point of view of the civil engineer, the Delta scheme is unparalleled in the engineering problems which it presents and in the skill and ingenuity exercised in their solution.

The Delta Scheme

The main idea of the scheme is simple—at least, when drawn on a map. It proposes excluding the sea from between the deltaic islands of the south-western coastline by a series of dams. Reference to the accompanying map, Fig. 1, will explain the scheme. Reclamation of new land is not a primary object, and the various arms of the sea enclosed by the dams would generally still remain as at present, except that they would become tideless and would be characterised by fresh water, replenished by the Rhine and Maas.

Sea defence improvements and reclamation have been going on in the area, on a smaller scale, more or less continually. For instance, one of the smaller sea openings, the Brielsche Maas, was closed by a dam in 1950. Four large sea openings are to be closed under the Delta proposals, namely, the Haringvliet, Brouwershavensche Gat, the Ooster Schelde and the Veersche Gat (Table I). These four main closures necessitate the construction of several secondary dams, and the division of the Delta into two regions, the southern being completely enclosed and tideless and becoming a vast fresh water reservoir on completion of the scheme, and the northern experiencing a very much reduced tidal cycle with a degree of control over the river outflows. These factors can be explained by following the scheme through from south to north.

Table I—*Primary Dam Sites*

Site	Approximate length of dam, kilometres	Maximum depth to sea bed, metres below N.A.P.	Tidal "cubature" of flow at mean tide, cubic metres
Veersche Gat	3	17	70×10^6
Haringvliet	5	12	250×10^6
Brouwershavensche Gat	5	30	300×10^6
Ooster Schelde... ...	8	45	1000×10^6

The southernmost arm—the Wester Schelde—is not dammed. The stipulated standard of sea defence is to be obtained here by heightening embankments. This arm serves the Belgian port of Antwerp, and must be kept clear for shipping.

Next we come to a group of works which were at one time proposed as a self-contained scheme, known as the " three-island scheme," since it linked together the islands of Walcheren, North Beveland and South Beveland. Note that on the map a neck of land is shown between Walcheren and South Beveland, and this does, in fact, comprise a recent reclamation which was the first step in the three-island scheme. Now, the linking of North Beveland with the two former islands to the south is well under way as part of the Delta scheme.

The main dam at Veersche Gat is of special interest as a prototype in constructional method for the two larger dams which will be built to the north ; this will be explained later. Construction of this dam necessitates closure of the other end of the channel by a secondary dam to limit tidal currents in the channel during the later stages of construction of the primary dam, and to exclude them altogether upon its completion. This secondary dam, which is called Zandcreek dam, will have a lock built into it, to allow passage of vessels using the Vlissingen-Veere canal. The dam at Zandcreek will be closed next year, and the Veersche Gat dam in 1961.

Now we come to the two largest and most ambitious dams of the primary chain, which will close the Ooster Schelde and Brouwershavensche Gat, respectively. Neither of these has yet been started, but under present plans, the latter channel will be closed in about 1970, and the former in 1978—the last stage of the whole Delta scheme. A necessary preliminary to these closures is the construction of Grevelingen secondary dam. The flood tides on either side of the island, Schouwen-Duiveland, meet at a point off the town of Bruinisse. The Grevelingen dam's position is a compromise between the exact meeting point of the flood tides—so that when it is built closure or partial closure at either primary dam site will not induce new tidal races round the island—and the best line for the proposed motor road which will pass across it. Construction of Grevelingen dam is now in progress, and will be completed by about 1963.

The southern section of the scheme will be completed by one other structure, the secondary dam at Volkerak. First, it should be noted that the dam closes only the Volkerak channel, and the arm shown on the map to the north crossing the Hollandsch Diep channel is a road bridge to carry that same motor road that will cross Grevelingen dam.

Volkerak dam will, like the two secondary dams already mentioned, obviate tidal scour at a certain stage of construction. In addition, it will have an installation of locks and sluice gates, and, when the scheme is complete, it will control the water level in the whole of the southern basin. The major rivers all discharge into the northern section. When they are in flood, in the winter or early spring, flow into the southern basin will be permitted, to give as high a level as possible to help water demands for agriculture during the summer. The three primary dams of the southern section will not have sluice gates or locks built into them. It is expected that the regions outside these dams will accumulate silt, after completion of the scheme, due to the much reduced tidal movements. Outflow from the southern basin will still be possible, however, through the Zandcreek dam and thence the Veere-

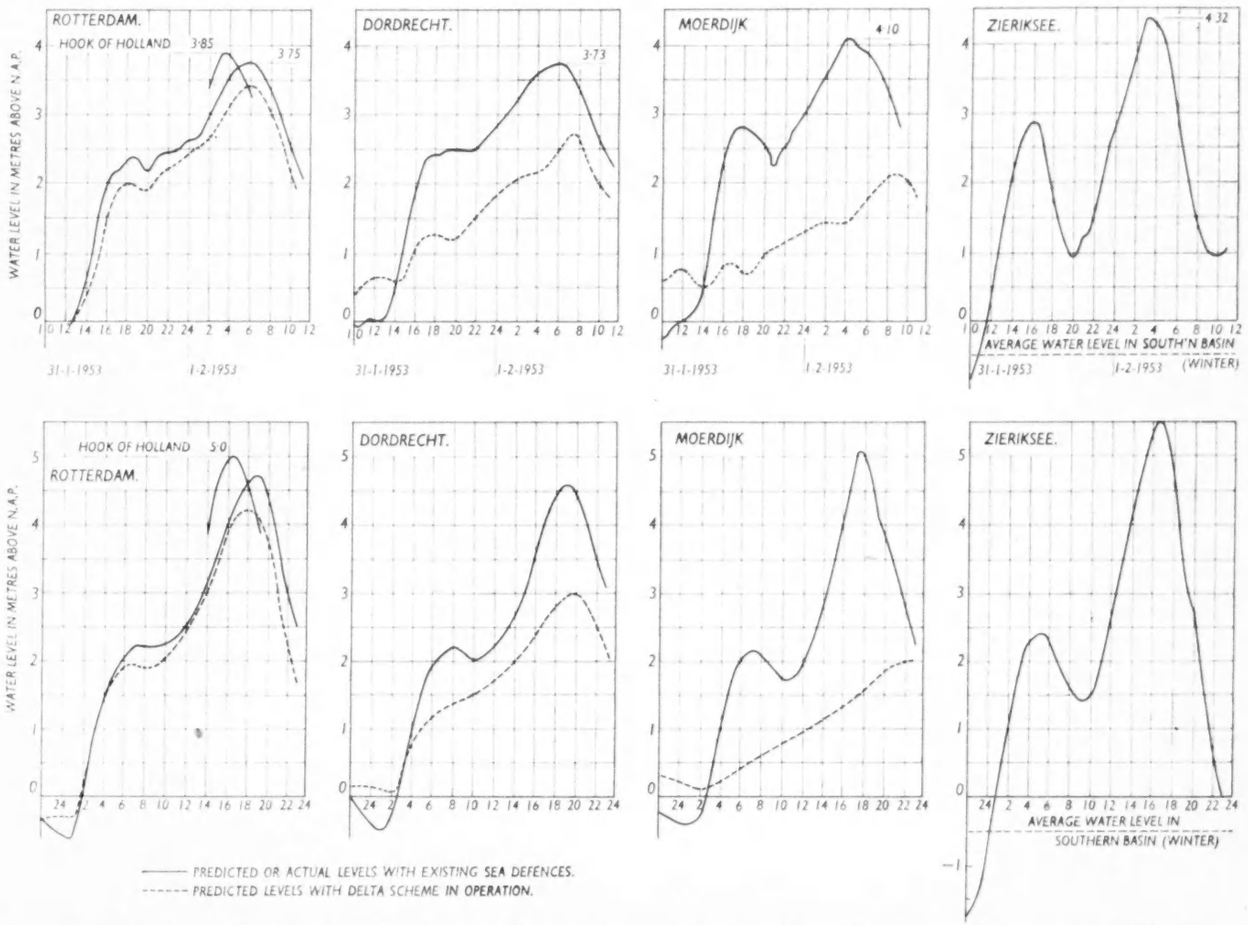


Fig. 3—Predicted and actual tidal levels at various delta towns, before and after completion of the scheme. The upper row of diagrams corresponds to the conditions of February 1, 1953, i.e. a peak tide of +3·85m N.A.P.* at the Hook of Holland, and a river flow in the Upper Rhine† of 1600 cumecs. More severe conditions, with corresponding figures of +5m N.A.P. and 3000 cumecs are shown in the lower row of diagrams. These latter conditions are now taken as the standard of duty which sea defences in the region must withstand

Vlissingen canal, or through the Zuid Beveland canal.

The Northern Section

Although demanding somewhat less construction, the northern section of the Delta scheme is more complex hydraulically than the southern section. This is due to the presence of the discharges of the Rhine and Maas, and to the port of Rotterdam, with its deep entrance canal, the Nieuwe Waterweg which is left open to the sea. The structures shown on the map are, first, one primary dam across the Haringvliet. This dam has been under construction since 1957 and is due to be completed by 1968. Its main difference from the other primary dams is that a large battery of sluice gates is being built into it. Operation of these sluice gates will give effective, though not complete, control of the river discharges and levels in the northern section. These sluices are in fact the key to operating the whole scheme.

Secondly, there is a surge barrier across the Hollandsche Ijssel river, which is able to close off that river completely should an exceptionally high tide occur. This structure is complete. Thirdly, the map shows a secondary dam separating the Oude Maas from the Nieuwe Waterweg. There is now doubt as to whether this dam will be built, since the future of this whole area is under review and there may be substantial changes with the construction of the "Europoort" project, a proposal to cater for the rapid growth of shipping using Rotterdam.

The Oude Maas dam, as originally envisaged, had a function different again from any of the other dams. The dam would have had sluices, normally kept closed. Under normal conditions, the Haringvliet sluices would be closed too; thus all the fresh water from the rivers would be channelled down the Nieuwe Waterweg, giving the maximum scouring out of salt water (approximately to the extent indicated by the shading on the map). With the incidence of a tidal surge, however, the Oude Maas sluices would have been opened, thus relieving the embankments along the Nieuwe Waterweg and along the Lek as the surge travelled up, by by-passing part of the surge water into the Oude Maas. This effect is shown specifically in Fig. 4, where, as can be seen, the rather critical levels in the +4m to +5m range would be reduced, at the expense of an unimportant raising of levels principally in the +1m to +2m range from Dordrecht onwards.

The effects on surge levels of various intermediate stages of construction is well shown in Fig. 4, but these diagrams should be considered as simply explanatory. Events have overtaken them to the extent that the Oude Maas dam's future is in doubt, as we have explained, and the intermediate stages (i.e. with Haringvliet and Grevelingen dams complete) have been modified because of political agreements concerning navigation between Antwerp and the Rhine.

Present plans in the region of the Nieuwe Waterweg, where storm surges can still penetrate, call for protection by heightening embankments. Thus embankment raising would extend right up the north bank of the Nieuwe Waterweg as far as the surge barrage, and then on up the Lek for 10km or 15km further. The whole of the island of Ijsselmonde would also be so protected (this work is in progress), together with those embankments facing the island on the opposite sides of the various channels around it.

It is clear that the only measure giving absolute exclusion of storm surges in the Rotterdam area would be a movable surge barrier across the Nieuwe Waterweg. This possibility has been studied, but opinion at present seems to be that the requirements for such a barrier (viz. to close a channel 300m wide without any intermediate structure obstructing the channel, and without any limitation on the height of vessels) are prohibitive.

Hence as the scheme is at present designed the northern basin will remain open at this one point, and will still be tidal, though with a much reduced tidal cycle. Control at the Haringvliet sluices will be similar to that now practised at the sluices of the Zuiderzee dam, and will require the interpretation of hydrological data collected over a considerable region of the Rhine basin. In addition, three barrages are to be built on the lower Rhine, the first of which, at Hagestein, is under construction. These measures will allow flexibility in the distribution of fresh water from the Rhine. In particular, the Ijssel lake (the lake behind the Zuiderzee dam) is to be raised slightly in level when a certain stage is reached in the reclamation schemes there, and the new Rhine

* N.A.P.=mean sea level, Amsterdam datum.
† i.e. above the point where the Rhine and Waal divide.

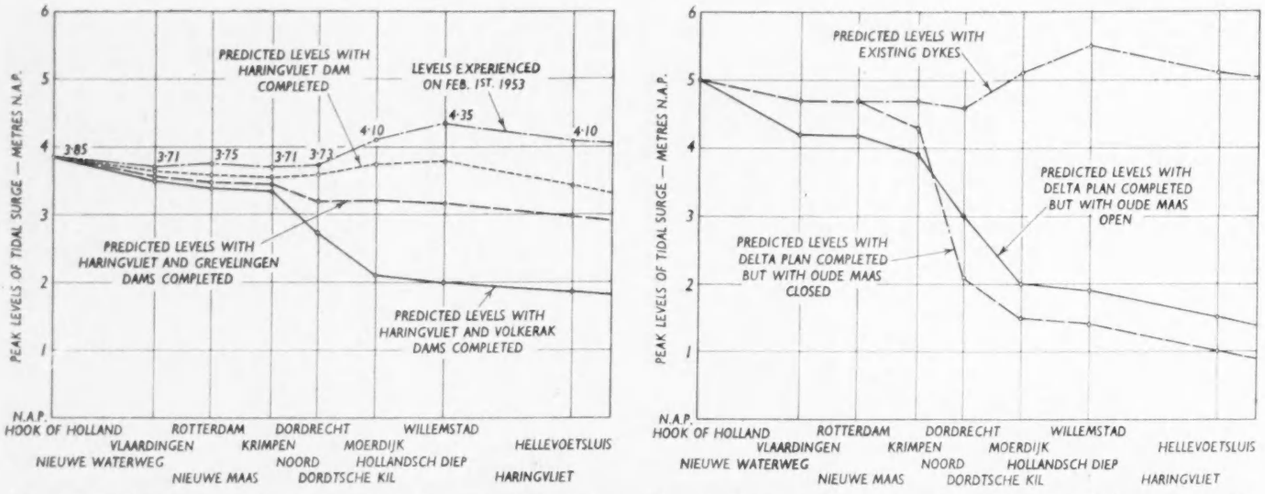


Fig. 4—Predicted storm surge levels in the deltaic rivers. The left-hand diagram shows levels corresponding to the surge of February 1, 1953, namely a peak tide of +3·85m N.A.P.* at the Hook of Holland and river flows in the Upper Rhine† and Maas of 1600 cumecs and 210 cumecs respectively. The right-hand diagram shows levels corresponding to a peak surge tide of +5m N.A.P. at the Hook of Holland and river flows in the Upper Rhine and Maas of 3000 cumecs and 500 cumecs respectively. These are the "design" conditions. The possible closure of the Oude Maas is discussed in the text

barrages will allow increases in the diversion of river flow to the Ijsselmeer.

Design Criteria for Sea Defence

It should be borne in mind that the 1953 storm surge had a great effect in changing opinion about the safety of the Dutch dykes. Indeed the same trend was obvious in this country, but the matter is not of such vital concern here. Prior to 1953, lay opinion in Holland was satisfied with the sea defences, and warnings of the possibility of exceptional storm surges tended to be laughed aside since there had been security for so long. The probability of occurrence of a surge as great as in 1953 is estimated by Dutch engineers as once in four centuries.

The degree of probability against which design of a structure or project must be undertaken is still a matter of controversy, and although the use of concepts of probability is gaining ground, for instance, in structural engineering, the stage has not yet been reached when there is a generally acceptable standard or code. A parallel which might be cited is in hydro-electric design; for certain run-of-river schemes in large rivers, the 1000-year flood is computed, and spillway capacities are adjusted to pass such a flood under extreme conditions, though a smaller flood is generally taken as the normal maximum discharge. There would appear to be much more at stake in the defence of the low-lying islands of South-Western Holland from the sea; reference to the first of the articles cited in our footnote will indicate the extent of the catastrophe actually suffered in 1953. So design for a probable frequency of once in 400 years would appear to be insufficient, and in fact the more severe conditions shown in Figs. 3 and 4 are now taken as the standard against which sea defences must be adequate. These conditions correspond to a probable frequency of occurrence of once in 10,000 years. This notion of probable frequency of abnormal conditions is quite new in the philosophy behind the design of sea defence works in Holland. Quite onerous calculations, based on records of tidal levels, river flows and weather conditions, were carried out to establish them.

Hydraulic Researches

The Zuiderzee scheme depended on the theoretical work of the Lorentz commission. Tidal movements in the Zuiderzee were studied, and mathematical analysis of great complexity was brought to bear, to predict the changes in tidal conditions at various stages during construction and after completion. The commission's prediction of tidal levels with the dam complete proved, in fact, to be remarkably accurate. The same class of problems is presented by the delta scheme, but, of course, there are now experimental methods available which are greatly in advance of what could be done at the time of the Lorentz commission's work.

Taking, for instance, the Haringvliet dam, it is necessary to know, as it was for the Zuiderzee, the velocity of tidal currents in the Haringvliet, and how they will be modified during construction, and whether the tides on the seaward face of the completed structure will be different from those experienced before it was built. These predictions prove complicated because the tides are not rising into, and falling from, an enclosed bay, as was the case in the Zuiderzee scheme, but into a maze of interconnected channels of varying sizes, depths and distances from the open sea. Thus it must be determined what the influence of any constructional work will be on the tidal currents, and also on the fresh water discharge from the rivers, in the whole system.

Work of this kind has, in fact, been undertaken with a "steady state" model of the Haringvliet (reproducing conditions at flood or ebb only) and with a tidal model covering the whole delta area, the results from which are correlated with similar work with an electrical model, which reproduces the various variable quantities of the problem by electrical analogy.‡ This electrical model gives results far more speedily than its hydraulic counterpart.

Benefits of the Scheme

Apart from the primary benefit of security from flooding, the delta scheme is advantageous for several reasons. The principal dams of the scheme, i.e. those facing the sea, will have a total length of about 20km, the sea coasts between them being largely protected by the great ridge of sand dunes which is characteristic of the Dutch coast. The length of sea dykes in the area of the scheme is, at present, 750km. Thus there will be a saving in maintenance when these dykes become of secondary importance, and they do not have to withstand tidal scour. Another factor of great economic importance will be the improvement of communications. The area generally, and particularly the two islands Goeree-Overflakkee and Schouwen-Duiveland, is somewhat isolated and sparsely populated, and practically without industry, except agriculture. The sea dams of the delta scheme will carry motor roads, thus replacing the present tedious ferry services with a modern highway network, and bringing the S.W. area up to the same standard as is being attempted throughout the rest of Holland. For communication by water some of the dams will have ship locks, and there will be less hazard for vessels plying within the relatively sheltered waters of the enclosed delta.

There is, however, another great benefit. Reduction of salinity in ground water has often been considered more important than the reclamation of new land in Dutch schemes of this kind. By flushing out this whole region with fresh water in place of salt water, its future as a farming area is rendered secure and more promising. Salt concentration is already high enough to impair agricultural production, and agriculturalists assert that in these conditions an acre of water is as valuable as an acre of land.

A "contour" map of salt concentrations in the ground water of the delta lands, based on measurements taken before the 1953 flood, shows that there was a concentration of over 5000mg of chlorine per litre over most of Walcheren, about half of Schouwen-Duiveland, and around a third of Goeree-Overflakkee, and in one or two other more limited areas. The coastal belt seaward of the line Bath–Rotterdam had, for the great majority of the land area, a concentration greater than 300mg per litre, increasing progressively towards the areas of highest concentration. Inland, the influence of salinity, as measured by the zone of 0mg to 300mg per litre concentration of chlorine, extended eastwards along a broad belt of land encompassing the three main rivers.

It was pointed out in our earlier article on the Zuiderzee scheme that the enclosing dam there had justified itself economically purely by its function of creating a fresh water reservoir. Much the same can be said of the dykes of the delta scheme. A stage of development is being reached where the supply of water is becoming a critical factor in future development. The delta scheme will thus provide major storage of fresh water, and in conjunction with the Rhine barrages, the Ijssel lake will be raised

* N.A.P.—mean sea level, Amsterdam datum.
† i.e. above the point where the Rhine and Waal divide.

‡ The theoretical basis of this method was described in an article by Dr. J. Van Veen, of the Rijkwaterstaat Tidal Research Bureau, entitled "Analogy between Tides and A.C. Electricity," and published in THE ENGINEER of November 28, December 5 and 12, 1947.

and the whole water conservation of the Dutch Rhine effectively improved. Salinity of coastal regions is added to this problem and the importance of banishing the salt water from such a vast area can hardly be over-estimated.

When the enclosing dams are complete, certain areas within the region will suggest the possibility of reclamation. A useful area of land may eventually be gained, and, indeed, the area at present between the mean tide and high water level is quite large.

Direction of the Delta Scheme

The " Delta " works were proposed by a committee of Dutch civil engineers, appointed by the Dutch government after the 1953 disaster, with much the same terms of reference as our own Waverley committee. The delta committee's proposals were subsequently adopted by the Dutch government and legislation was passed to enable the works to start. Actual design and supervision of construction is in the hands of the Delta Service, which is a branch of the Rijkswaterstaat, the governmental engineering body which holds responsibility for most of the reclamation, canal and road works in the Netherlands. The Delta Service is divided into divisions responsible for the northern and southern sections of the scheme, the chief engineers of these two sections being respectively Ir. M. de Bruijn and Ir. H. A. M. C. Dibbits.

Principles akin to the Delta scheme were contained in a report by Dr. Van Veen published two days before the 1953 disaster which pointed out that the crest levels of the dykes were determined by unsatisfactory methods. This was one amongst many proposals. The Delta plan in its present form is, however, bolder in conception than were most of the alternatives. Because of this wide interest in the problem, and the extent of the investigations done before 1953, the delta committee was able to report with firm proposals within a year, and the Delta act had been passed by the Second Chamber of the Dutch parliament by 1957.

Construction of Haringvliet Dam

IT was pointed out in our introductory article that hydraulic control would be exercised at only one of the primary dams of the Delta scheme, namely, the Haringvliet dam. A battery of sluice gates of large capacity is to be incorporated in the dam, and construction has been arranged so that the sluice gate installation is being built first, within the cover of an enormous cofferdam or ring dyke. The cofferdam was completed over a year ago, and this aspect of the Haringvliet dam alone, involving construction virtually in the open sea, would appear to have been a civil engineering task without parallel.

The central section of the dam, with the sluice gates, will be of reinforced concrete, with embankments on either side, except for a harbour with a lock allowing passage through the dam, for vessels of up to 2000 tons. This summer work was started on a second, smaller, cofferdam for construction of the lock.

The first work to be put in hand at the Haringvliet was a harbour for use during construction of the dam, as a base for the craft and floating plant in use, and as a store for materials. This harbour was a major work in itself. It consists of embankments built of sand fill, with concrete blocks facing the inner banks, and the outer banks protected by fascine mattresses below mean sea level, and faced with asphalt above. The harbour is next to the old harbour at Hellevoetsluis, as shown in Fig. 6.

The Sluice Gate Structure

The sluice gates of Haringvliet dam, and the structure which will carry them, are shown in outline cross section (modification of detail is still possible at this stage) in Fig. 5, from which the ingenuity shown in meeting all the requirements of the design will be apparent.

There will be seventeen openings, each of 56·5m, separated by piers each 5·5m wide, in the complete structure, giving a total sluice opening of 960·5m to the sill depth of —5·5m N.A.P. The maximum computed flow through these openings for a head of 0·75m is 22,500 cumecs.

The sluice gates are to be sector gates, each spanning the 56·5m, and duplicated in each opening in the manner shown to give an acceptable margin of safety. They will be operated by hydraulic machinery installed at each pier, and the hinge bearings will be carried on the lower sides of the enormous triangular beam spanning each opening. These beams will be of prestressed concrete and will have a depth of 12m. They will carry a motor road 22m wide, on the flat top of their triangular cross-sectional shape, and on slabs cantilevered on each side.

A triangular cross section proved convenient for the combination of loading on these beams due to the road and the sluice gates. Design of this whole structure was influenced by the dynamic effects of waves against the sluice gates.

Several methods were used to analyse the effects of dynamic wave forces on the gates. First, the whole structure was considered as a double mass and spring system, the two masses being those of the gate and beam, respectively, and the two springs the combined bending and shear rigidity of the gate and beam respectively. Straightforward computation gave the result.

In a second method, the differential equation (d'Alembert's equation) for this dynamic system was solved : (*a*) by methods of successive approximation using sine functions and eigenvalue functions ; (*b*) approximation by the method of characteristics using an electronic computer for the numerical work, and (*c*) by an electrical analogue, in which moments, shears and displacements were expressed as a function of time and place in the structure. This last solution involved consideration of sections of finite length, (infinitely small cross sections were considered in methods (*a*) and (*b*)) but it is considered that errors of only a small order were introduced as a result.

A third method was used, viz. photoelastic investigation of a model of the structure. The results obtained by the three methods were cross-checked and correlated together.

The structure just described will be carried on load bearing piles. The substructure will extend as an apron for a width of 92·5m, the apron having double steel-sheet-pile cut-offs at each side and being piled to resist uplift pressures. The 1 : 5 slopes, trimmed down to the new sea bed level on each side, are to be protected with very extensive covering with fascine mattresses and dumped stone, which is not shown in the cross-sectional drawing.

The Cofferdam

Construction of the permanent works of the sluice structure started this spring and the permanent embankments of the dam are still in the future. The main interest at present therefore is centred on the cofferdam within which the sluices are being built. The overall dimensions of the cofferdam, measured to about sea level on the outer slopes of the embankments, are a length of about 1400m, and a width of about 560m, with a small harbour on the inner, sheltered side. When the cofferdam site had been selected, the next step was an extensive programme of test drilling from floating plant. This work is still in progress, but after a year (in 1955), sufficient data for preliminary design were obtained. Construction of the cofferdam has now been completed, but before going on to a detailed description of this unusually interesting, though hazardous, constructional feat, and to the cofferdam itself, some physical data about the Haringvliet should be given.

The Haringvliet

At the site where the Haringvliet will be dammed, its width is about 5km. Generally, it may be described as an estuarial channel in regime. It is shallow, but there are two channels which are relatively deep. The principal one on the north side is known as the Rak van Scheelhoek, and the small one on the southern side is called Noord Pampus. Depths in the large northern channel had, before work started, a maximum of 12m, and in the southern one of 5m, below N.A.P. Between the two channels is a shallow area of sandbanks where the cofferdam has been sited. Here the depths are from —2·00m to —8·00m, the region close to the Rak van Scheelhoek being the deepest.

The sea bottom consists of fine sand (100/200μ particle size) with thin seams of clay and silt in it. Clay and silt are found in greater quantities in the southern part of the cofferdam site. Up to nearly 40 per cent of clay and silt, over a limited range of levels, was revealed at one trial hole, but more generally, only about 10 to 15 per cent of the sea bed is of these materials, the sand predominating. Variations in depth of about ½m occur over, say, a six months' period. The more general configuration of a large northerly channel separated by

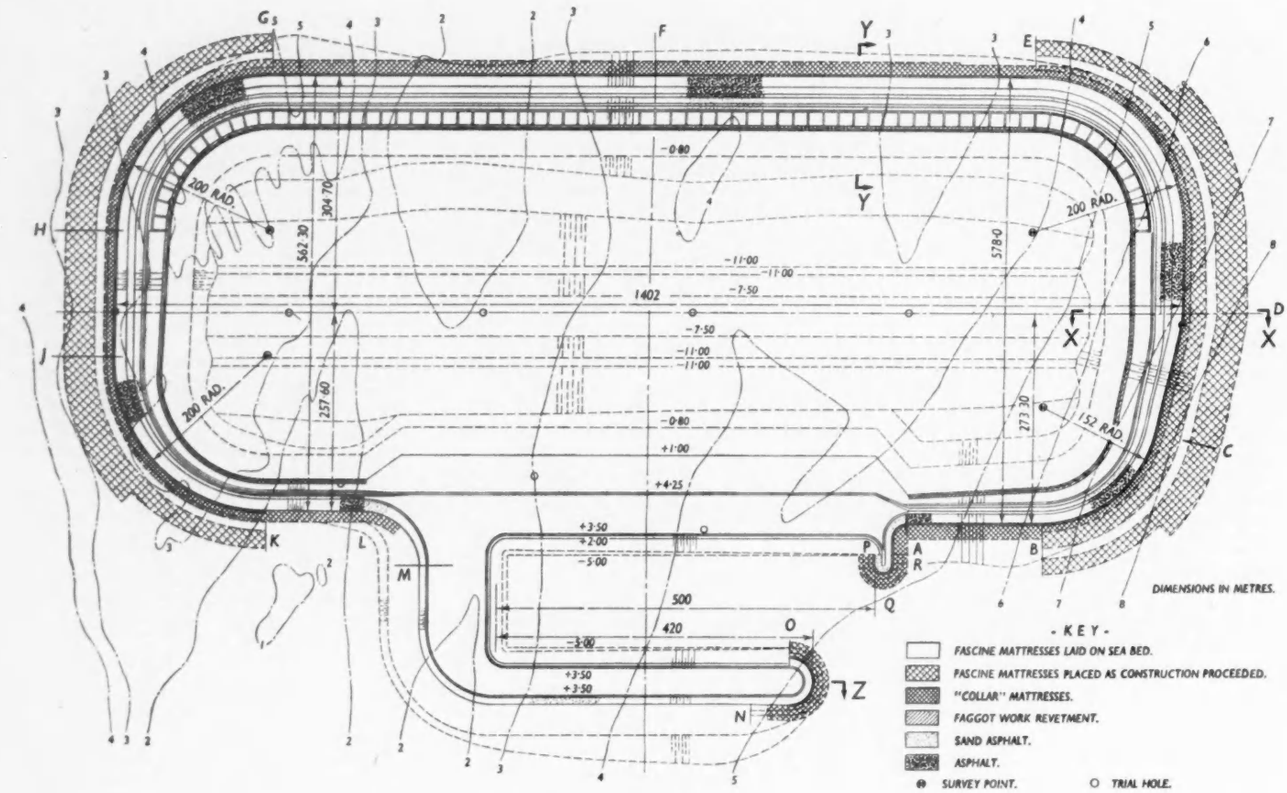
TABLE II—*Tidal Data for the Haringvliet*

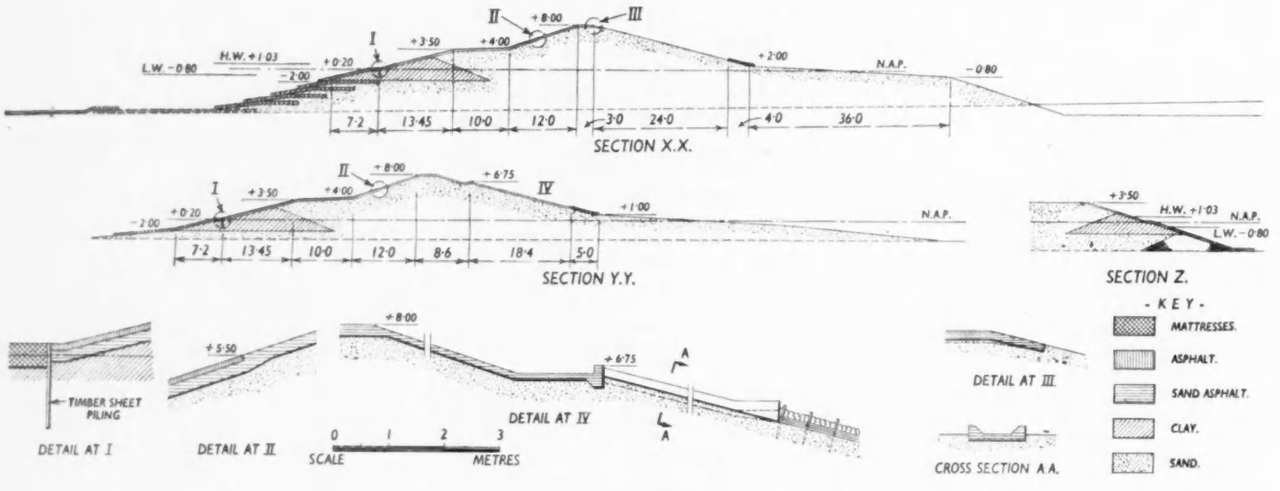
	Ordinary Spring tide	Mean tide	Neap tide
High water	+1·16	+1·03	+0·87
Low water	—0·82	—0·80	—·078

Frequency of Exceptional High Water at the Haringvliet

In the month of :	100-year frequency	20-year frequency
January	+3·35	+2·90
February	3·12	2·72
March	2·80	2·48
April	2·40	2·15
May	2·10	1·86
June	2·12	1·90
July	2·30	2·05
August	2·52	2·22
September	2·78	2·45
October	3·15	2·70
November	3·45	2·95
December...	3·50	3·02

High tide on February 1, 1953... ... +4·10
Low tide on February 22, 1885... ... —2·26
Levels are in metres, related to N.A.P. datum.





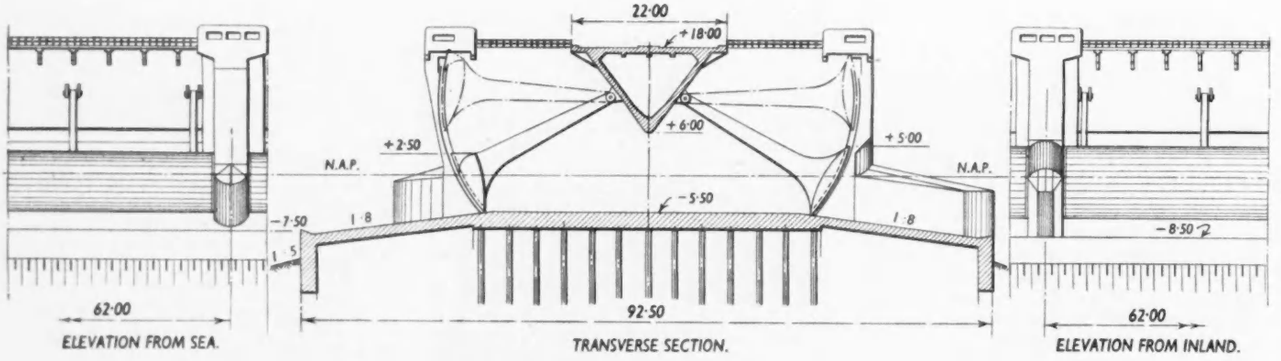


Fig. 5—The Haringvliet cofferdam. Initially excavated levels inside the cofferdam are shown on the plan as well as the original contours of the sea bed. Two cross sections are shown to exemplify the construction of the cofferdam as a whole. The lower view is an outline drawing of the sluice gate structure now being built inside the completed cofferdam

shallows from a small southerly one, is, however, constant. Tidal currents, before work started, were normally of the order of 1m per second velocity, increasing to about 1·5m per second for spring tides. Tidal data are given in Table II.

Three alternative sites were considered for the cofferdam, namely (i) the Stellendam site, which was in fact chosen, and is the one shown in the drawings; (ii) a site further inland between Hellevoetsluis and Dirksland, and (iii) further out to sea at Kwade Hoek. The latter had the advantage that it gave the maximum shortening of the coastline, but it was considered that a cofferdam in this position would be too vulnerable to damage from waves and that wave forces on the sluice gates of the completed structure would be too great. The innermost alternative, in the channel opposite Hellevoetsluis, gave the most sheltered situation, and also the position where the Haringvliet was narrowest. The disadvantage here was that the restriction to tidal flow offered by the cofferdam would have caused serious erosion close to the two coastlines, and possible damage to the breakwaters of the harbours at Hellevoetsluis and Dirksland.

The diagram, Fig. 6, gives interesting data on the rough seas which might be expected over a period at the Stellendam site, showing the percentage of time that waves of a certain height were actually experienced in 1955. Monthly diagrams of this kind were supplied to the contractor. This site was also favourable for the extent of shallow sea bed on which the cofferdam could be built. Its construction would result in a decrease in cross-sectional area of the channel of 30 per cent, which would remain for some years. It was considered, however, that this would not seriously affect the "regime," since the deeper channels on each side would scour out to restore the cross section, and the overall equilibrium would not be seriously disturbed. For the same cubature of flow, a mean deepening of 2m to 3m in the neighbourhood of the cofferdam was predicted, with possible local levels on the north side of −9m to −18m N.A.P. Similarly, the south channel would increase in depth by some 3m.

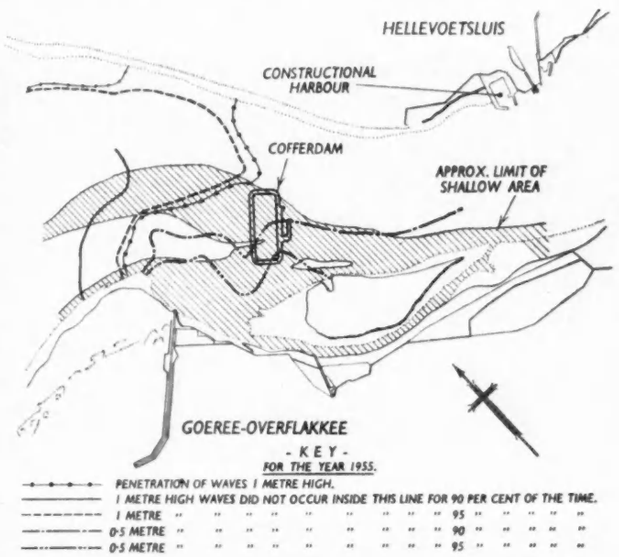

HELLEVOETSLUIS
CONSTRUCTIONAL HARBOUR
COFFERDAM
APPROX. LIMIT OF SHALLOW AREA
GOEREE-OVERFLAKKEE
- K E Y -
FOR THE YEAR 1955.
PENETRATION OF WAVES 1 METRE HIGH.
1 METRE HIGH WAVES DID NOT OCCUR INSIDE THIS LINE FOR 90 PER CENT OF THE TIME.
1 METRE " " " " " " " " " 95 " " " " "
0·5 METRE " " " " " " " " " 90 " " " " "
0·5 METRE " " " " " " " " " 95 " " " " "

Fig. 6—The Haringvliet, showing the position of the cofferdam, the constructional harbour, and instantaneous wave patterns as measured during the year 1955

Research Problems

Site measurements and hydraulic model studies were undertaken to supply detailed information by which the design and performance of the cofferdam could be assessed. The diagram, Fig. 6, referred to above, represents some results from one group of studies of this kind.

The principal hydraulic model, which was made at the laboratory at Emmeloord, had a horizontal scale of 1 : 150 and a vertical scale of 1 : 50. It was not a tidal model, but could reproduce steady-state conditions corresponding to either the maximum flood or ebb flow. Apart from studies of the alternative sites for the cofferdam, the model was used to ascertain the relative effects of local scour during construction at the site actually used, for different shapes of cofferdam, as described further on. Waves were studied at Delft laboratory on a model of 1: 1250 horizontal and 1 : 250 vertical scales. At these scales, friction and surface tension effects, it was considered, would introduce inaccuracies, and so full-scale verification was sought. Quite elaborate measurements were made at the Haringvliet on three reference lines, one to seaward, one further inland, and one corresponding to the centre line of the cofferdam. Wave patterns were also studied by radar; this aspect of the study was valuable in ascertaining the local turbulence which is the immediate cause of scour.

Constructional Principles

It was assumed that a 3m tide produced a maximum current of 1·8m per second in the Haringvliet, and this would be increased locally to 2·5m per second by the cofferdam. Special attention was given to the flow around the corners of the cofferdam and along its north and south edges, so that erosion could be minimised. A minimum radius of 200m was thus ascertained for three of the four corners, and the fourth, the north-east corner (the region *BD* on the plan) was tapered, as the plan shows.

It was considered that a crest level of +8m on the seaward side, with a berm 10m wide, at +3·5, would give adequate strength. A longitudinal drainage channel on the inner slope, connected at intervals with transverse drains, was considered necessary, to handle any sea water which overtopped the embankment. These transverse drains are not shown in the sections and details on page 342, though perusal of these sections, together with the detail views and the plan, will give a good idea of its construction. Table III gives some principal dimensions and quantities.

The method of carrying out the constructional work was basically to get the cofferdam built in as short a time as possible. It will be appreciated that such work is not by any means without hazard. In the early stages, when the first part of the embankment appeared above water, the little island thus formed was especially vulnerable to gales and bad weather and could have been completely destroyed by a storm at that time. Until the ring was closed, the open end where work was in progress was also a vulnerable spot. Added to this, complications were expected in constructing the northerly section of the embankment, in the region of deepest water and greatest tidal flow, where erosion was expected to be the most severe.

It was therefore decided to build the cofferdam in one season. In spring and summer the two most exposed lengths on the outer sides (approximately the region *J* to *C* on the plan) were to be built and consolidated before the autumn storms. In autumn the part of the project lying in a more sheltered region was to be executed, and during the winter the works could be completed. A considerable concentration of floating plant was needed to keep to this programme.

Construction of the Cofferdam

Constructional work at the cofferdam site started on February 15, 1957. In the region *HJ* on the plan, clay was dumped on the sea bed to form a bank in the direction of the stream. Sand was then dumped against the clay bank. As the raising proceeded, however, clay cross dams were needed to deflect the current from the sand. Work proceeded towards the north, first building the clay bank on the outer side of the ring. The clay was dredged from the Hollandsch Diep at depths of 10m to 20m. Sand was dredged from the sea bed nearby. The clay banks were built by floating grabs, taking the clay from barges. Sand was then pumped behind the banks or into the space between the clay banks where more than one was necessary. Filling continued by the same general method, using either clay or sand berms to form settling ponds. Where only the outer clay wall was necessary, the sand fill took up a shallow surface slope, extending across the area eventually to be enclosed by the cofferdam. The clay construction on the outer side eventually had, as a minimum, the shapes shown in the cross-sectional drawings.

All of this work was, of course, extremely vulnerable to wave and tide, and protection against wave action was needed at the first opportunity. The lower parts of the slopes were, therefore, protected by willow mattresses, floated into position and then sunk by loading them with stone. These fascine mattresses, as they are often called, are in effect flexible rafts. Bundles of willow twigs are tied together to form a sort of "rope" of twigs, about 6in in diameter.

Table III—*Dimensions and Data for the Haringvliet Cofferdam*

Length (between timber sheet piling)		1402m
Breadth (between timber sheet piling):		
On north side		578m
On south side		562·3m
Crest level of embankment on seaward half		+8·0m N.A.P.
Crest level of embankment close to harbour		+4·5m N.A.P.
Width of embankment at −7·5m level		146m
Harbour dimensions:		
Width between embankments at N.A.P.		150m
Length of arm on main bank		500m
Length of outer arm		420m
Dredged depth		−5m N.A.P.

	Below −2m N.A.P.	Above −2m N.A.P.
Sand fill in cubic metres, in ring bank and harbour mole:		
Section *BE**	340,000	251,000
EG	153,000	431,000
GK	118,000	236,000
KL and *AB*	76,000	73,000
Harbour mole	302,000	683,000
Total sand fill	2,663,000 cubic metres	
Excavation inside cofferdam	1,362,000 cubic metres	
Sand dredging in harbour	58,000 cubic metres	
Clay in embankments	180,000 cubic metres	

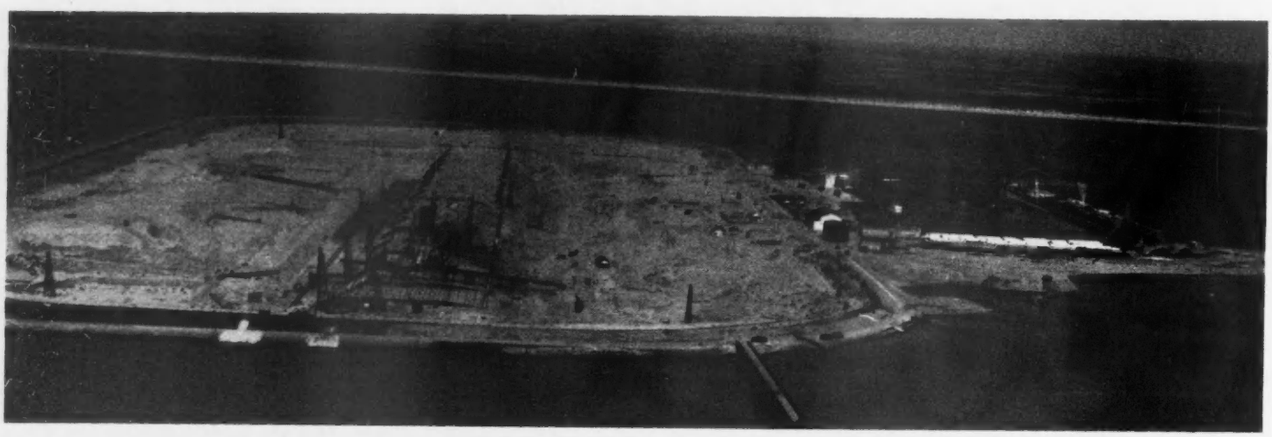
Construction of outer face of embankment:	
From *A* to *K* clay from	−2·00 to +2·00
R to *A* clay from	−2·00 to +1·50
P to *R* clay from	−2·00 to +3·50
O to *P* colliery shale from	−2·00 to +2·00
N to *O* clay from	−2·00 to +1·50
K to *M* clay from	−1·50 to +1·50
N to *R* colliery shale from	Bottom to −2·00

Dimensions of caissons in ring embankment: 7·5m by 11m by 6m, 3m or 2m depth

Note: Other main quantities are given in Table IV.

* See Fig. 5 for reference letters.

Figs. 7, 8 and 9—The Haringvliet cofferdam RIGHT, during construction of the ring embankment in 1957, showing floating plant at work. BELOW, a recent progress photograph (taken on August 18), showing piling plant at work, and, in the foreground, a Bailey bridge linking the cofferdam with the smaller cofferdam for the lock, built this year. At the FOOT OF THE PAGE is a bird's-eye view of the large cofferdam, as it was last May



These " ropes " are fastened together into a mesh, with squares of about 1m. A thick mat of willow twigs is then held between two such meshes, to form the complete mattress. Mattresses may be very large—up to thousands of square metres in area—for difficult situations. When floated into position, stone is placed on them by hand from barges alongside, until they sink. The stone is basalt, which has a high specific gravity and is thus very suitable ; basalt from Germany and stone from the Maas valley in Belgium are virtually the only materials which the Dutch import for these works. A mattress and the stone which sinks it, together occupy a depth of about 1m. An idea of the areas covered close to the embankment and the extent of overlapping can be gained from the cross sections.

Above tide level, the principal method of protection for the sand fill in the early stages was by a surface layer of sand-asphalt. This was a lean mixture of sand and bitumen with about 6 per cent of bitumen. Construction proceeded in the manner described as far as the centre line of the north-west side of the cofferdam. Some progress was made in the region *JL* but here the shallowness of the sea hindered progress for the cranes and barges could not navigate at low tide.

The Check Structure

While work was proceeding along the length *H* to *F*, as just described, a start was also made along the north-east side of the cofferdam. Here, the greatest depths of about 8m were encountered, and the tidal currents were strongest. An intermediate stage of construction was considered necessary here, so as not to alter the natural pattern of currents too much at an early stage. A " sunken dam " was therefore built up to the —2·50m N.A.P. level. This was done by depositing sand, in bottom-dumping barges, alternately with fascine mattresses. Fast progress was essential, and mattresses were sunk four times a week, and in each case a thickness of 0·5m to 1·5m of sand deposited on top of them. A length of 700m was built up in this way, and sand was dumped at a rate of 25,000 to 30,000 cubic metres per week for many weeks.

The next stage was the construction of a check dam at the northern corner, on top of the northern end of this area where the sea bed had been raised. The reason for the check dam had been made clear from the model test. As construction of the main embankment proceeded northwards in the direction *GF* on the plan, so tidal flow was deflected more severely over the sunken dam, causing turbulent flow to travel down its undefended inner edge which would have severely damaged it. The check structure was therefore stipulated, to be built across the sunken dam, and so divert the flow either into the deep channel, or into the gap remaining between it and the completed embankment. Ebb currents also became more destructive at this stage, so a protective bank was called for on the inner side of the main embankment construction. The gap between the two banks was finally to be closed by reinforced concrete caissons. The cross-sectional construction of the embankment with caissons incorporated in it, is not shown in any of the drawings, but will, we think, be clear from the ensuing description. The caissons were, in fact, already in existence, having been left over from the work of closing the Schelphoek breach in 1953.

Fascine mattresses were sunk, from the " sunken dam " along the line of the inner side of the completed embankment, as far as its centre line, i.e. along the length *EF*, and across the gap just referred to. The check dam, consisting of relatively coarse material—ballast of 4cm to 30cm grading—was then built upon a length of 200m of this fascine base at the north corner. Its seaward face was protected from wave action by tipped stone and it was built up to normal high water level.

At the same time, construction of the main embankment proceeded northwards, the sand fill being enclosed by a clay bank on the outer side, and by a ballast bank on the inner side to protect the sand fill from the ebb currents.

The closure was made by twenty caissons, which were towed in in units of three, four or five, and sunk on a dam of ballast, built up to a level just below low water, on top of the fascine mattresses and forming an extension of the check dam. With the caissons in position, sand was pumped into the sea bed across the gap, along the line of the outer edge of the finished embankment. The normal clay bank was then built on this sand. Then the space between the clay bank and caissons filled with more sand. A second-stage clay bank was needed to bring the fill up to the required height, the caissons being entirely buried in this second stage. Finally, a protective cover of asphalt was laid on the seaward slope of the embankment.

This gap in the northern corner was closed on July 2, 1957, thus making secure this part of the construction. The highest current recorded in the gap was 2m per second. About 700m of embankment had been constructed in a few weeks. The next phase of construction involved building and strengthening the permanent embankment on the north-west side, above the " sunken dam," and completing the more sheltered part of the embankment.

Completion of the north-west embankment was, in fact, essential before the autumn gales set in, as demonstrated by a gale at the end of August of that year, which caused considerable damage at the corner, which was rapidly repaired. A special premium of 10,000 guilders per day would have been paid to the contractor if the embankment *HFB* had been built above +3·00m N.A.P., before August 14, but this was not achieved. The longitudinal centre line of the cofferdam was reached by September 10.

The winter method of working was then adopted, keeping the " open end " where construction work was in progress as small as possible, and sealing close behind it with asphalt. Thus by the end of the summer, more than half of the cofferdam embankment had been built. The exposed half on the seaward side had been completed, and on the sheltered side, a good start had been made with the embankment, and some work done on the harbour banks.

Progress was then concentrated on the east or inner side of the cofferdam. A dam of colliery shale was placed along the inner side of the harbour and sand pumped alongside it to extend the main embankment. Thus the ring was completed except for the final gap *AB*. The flow through this gap was about 800,000 cubic metres on each tide. The gap was closed on November 12, 1957, by plugging it with a clay dam, resting on a bottom protected by fascine mattresses. This was a critical operation, and the plant assembled for the closure consisted of two floating cranes, served by decked or " flat " barges, four bulldozers, six draglines, one suction dredger and a barge-unloading dredger and sand barges.

Some floating plant, namely, two cutter dredgers, one unloading suction dredger and three barges, were left inside the ring, to carry out excavation " in the wet " to as near the final excavated shape as practicable. Two syphons were built over the embankment to top-up the enclosure with water, and thus serve the suction dredgers and keep the plant afloat. Dredging inside the cofferdam was finished and the inner slopes of the embankments were sown with grass to prevent wind-borne sand losses, by early May of last year. On May 11, 1958, the gap *AB* was reopened for one day, and the floating plant taken out through it. When it was resealed, the cofferdam was ready for a start to be made on dewatering. At this stage, progress had lagged a few months behind the scheduled programme.

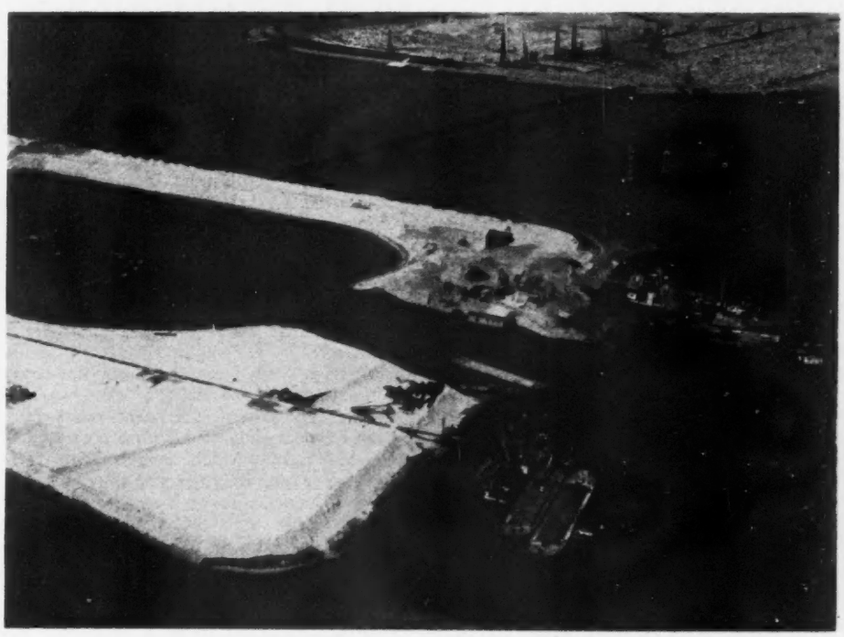


Fig. 10—The small cofferdam for the ship lock of Haringvliet dam. A dredger is at work inside the ring embankment; the Bailey bridge leading to the large cofferdam is shown

Plant and Progress

Some details about the plant employed on the construction of the cofferdam may be of interest. Suction dredgers were used to win sand from the sea bottom. As soon as the first part of the embankment had been built above sea level, three asphalt plants were erected on it. Where possible, hopper-barges were employed, but generally clay was placed by grabs, and sand was pumped from the barges by unloading suction dredgers moored beside the work. More of these plants were put to work in the lee of the embankment, as it was extended.

The principal plant at work was as follows: three bucket dredgers; thirteen suction dredgers; four floating grabs; eleven hopper and bottom-dumping barges; twelve "elevator" barges; thirty flat barges (for stone and clay); twenty-two tugs; thirteen motor-boats; seventeen draglines; three asphalt plants; 1·1km of floating pipeline and 3·5km of pipeline on land.

Weekly production of sand reached a maximum of 100,000 cubic metres. Clay was brought to the site at a rate of about 10,000 cubic metres per week, and ballast for the check dams at 5000 to 7000 tons per week. Basalt for sinking the fascine mattresses averaged 4000 to 5000 tons per week, and colliery shale 9500 tons per week. The mattresses themselves were made at rates varying from 3000 to 10,000 square metres per week.

Outline details of the contract for constructing the cofferdam are given in Table IV,

Table IV—*Contract Details for the Haringvliet Cofferdam*

Works included in the contract:
(*a*) Build the ring embankment.
(*b*) Dredge inside it.
(*c*) Build harbour mole and harbour.
(*d*) Dredge harbour.
(*e*) Build auxiliary sub-structure to control currents.
(*f*) Complete ancillary works; and
(*g*) Maintain for six months.

Contract sum = 17,674,000 guilders.

Principal unit prices and quantities

Item	Unit	Price (guilders)	Quantity
1. Fascine mattresses on outer side of embankment, sunk with stone 250kg/m²	m²	9·50	101,000
2. "Collar" mattresses at higher levels (250kg/m² of stone)	m²	6·0	51,500
3. Light faggot work revetment, 200kg/m² of stone	m²	2·0	12,500
4. Sand asphalt	m³	92·0	23,000
5. Asphalt	m³	140·0	6,500
6. Timber sheet piling ...	m	55·0	3,850
7. Concrete edge beams ...	m	8·0	920
8. Rubble	m³	20·0	450
9. Clay	m³	16·0	3,000
10. Groyning and light Sisal matting ("Koreamat") revetment	m²	1·25	3,100
11. Tipped stone in embankment	ton	5·0	53,000
12. Conveying colliery shale to site	ton	6·75	125,000

£1 = 10·60 guilders

and we have included the unit prices quoted by the consortium of contractors which carried out the work. The contract was a fixed price one, and the list of unit prices—which incidentally included all the principal items of work except the excavation or placing of sand and one category of clay bank construction—was included as a basis for possible variations in the work, and these quantities only were binding in relation to the contract sum.

Construction of the Sluice Substructure

On completion of the cofferdam, the commencement of work on the permanent structure which is to be built within its cover brought a change of emphasis, and the site is now equipped in an equally comprehensive way for this task as the illustrations on page 344 clearly show. The emphasis at present is on piling, but an elaborate installation for lowering the ground water table is in operation, and a constructional power station of 770MVA capacity is in use.

The latest progress figures we have relate to work up to July. By that time, excavation for the central, horizontal section of the sill of the structure was complete, at a formation level of −6·4m; two-thirds of the total excavation at a lower level had also been done, i.e. to −8·96m on the "river" side and to −13·4m on the "sea" side as far as the sill and apron are concerned, but deeper in other situations.

The ground water control is in two stages, lowering to −10m and −18m, respectively in various situations. In the deeper excavations extensive enclosures of steel sheet piling are called for. In the three months prior to midsummer, 239,000 cubic metres of excavation, out of a total of 587,000 cubic metres, of "dry" excavation within the cofferdam was completed and tipped. The total requirement of steel sheet piles is about 24,000 tonnes, in lengths from 3m to 21·25m, of which 8000 tonnes had been driven.

There will be around 22,000 concrete piles in the completed substructure, their lengths varying from 8m to 24m. Most of them will be 0·4m square in cross section, but a few will be slightly larger. In February of this year, forty-nine test piles were driven in pier No. 9, and deep borings were made to ascertain the principal properties of the surrounding soil, both before and after driving, and in particular to find out if the density of the soil had increased in the immediate neighbourhood of a group of piles.

The main programme of driving concrete piles started last March. Five piling frames are in use, in such a manner that, as a unit, they cover the entire width of the apron of the sluice structure and so they will gradually traverse the site longitudinally as piling proceeds. Two further frames are in use at one of the "abutments" of the sluice structure. By midsummer the concrete piling for the sill of bay No. 17 had been completed, and piles were being driven in the bays and for the piers at bays 14 to 16. Over 2000 piles had been driven. The piling programme depends on extensive testing, and the lengths of the piles at each pier are determined after soil tests. The bearing stratum is a dense sand.

Design and supervision of construction of the Haringvliet cofferdam, and of the permanent works of the dam itself, is being carried out by the northern section of the "Delta Service" of the Rijkswaterstaat. The engineer responsible for constructional work at the Haringvliet is Mr. P. A. van de Velde. A contract for the construction of the cofferdam was let to Haringvliet N.V., a consortium of four Dutch firms, namely, R. Boltje en Zonen N.V.; Aannemingsbedrijf Oosterwijk N.V.; N.V. Reef's Aann. en Handel Mij; and Aannemingmaatschappij P.C. Zanen N.V. The main contractor for the construction of the sluice structure inside the cofferdam is N.V. Nederlandse Sluis- en Tunnelbouw Maatschappij of Amsterdam, the contract sum being 96,250,000 guilders.

This article is based on information gained in visiting the site, for which our thanks are due to the Delta Service. However, we have also drawn some of the facts about the progress of construction of the cofferdam from an article in *De Ingenieur* of March 28, 1958, written by Mr. van de Velde, to whom acknowledgment is due.

Veersche Gat Dam

PROGRESS in the construction of the Veersche Gat dam will be watched with great interest by many engineers, on account of the novelty of the methods in use there. This dam is regarded as a full-scale experiment to test the methods which will be used for the larger dams to be built subsequently across the two openings to the north.

The remaining primary dam, the Haringvliet dam, is rather a different proposition because its sluice gate installation entailed a different approach to its construction as we have just described. But even here the maximum depth is less than at the other sites; Table I gives the figures relevant to a comparison. Although the Zuiderzee dam, which was completed in 1932, was much longer than any of the Delta dams (the length of the main stretch of dam is 18½ miles), the closure was relatively much easier because of the shallower water and smaller "cubature." It was possible to build submerged "sill dams" to limit the depth of final closure to 3·5m; even so, the Zuiderzee closure was a hazardous proposition, and the dams now proposed show the great strides which have been made in civil engineering over the past thirty years.

The final closure at Veersche Gat dam will be made with seven large reinforced concrete caissons. In all these closure operations, the problem has been that as the gap narrows, the tidal race through it increases in velocity and in its power to scour out the gap. It thus becomes a race to plug the final gap more quickly than it is scoured away. Since the war, Dutch civil engineers have increased their power to overcome this problem by several methods. One of the most promising utilises reinforced concrete caissons which are towed into position at slack tide, when stability is temporarily reached at the gap, and then sunk to block it, before the tidal race has time to establish itself.

This method has its limitations. It presupposes the existence of a flat, relatively stable (i.e. scour-resistant) bed on which to "land" the caissons. The "landing" process is not without hazard, and clearly the number of caissons which can be placed in a tide is limited.

The closure at Veersche Gat will take this method a step forward—a considerable step which will extend it sufficiently to cope with the two larger dams, according to present ideas. Each of the seven caissons will be almost as large as the "Phoenix AX" caissons used for the Mulberry harbour. But they will be constructed with open sides, and with sliding gates on one side. The gates will be lowered and the opposite side temporarily closed with timber for the floating-out operation.

When one caisson is sunk in position, the gates will be raised and the timber removed, thus allowing the tides to flow through it. In this way a wall of caissons will be gradually placed, without increasing the tidal currents above a limiting value. Joints between caissons and stability beneath them will be checked, with quasi-normal tidal conditions and stone will be dumped along the "toes" of all the caissons, below

the level of the openings. Finally, at slack water, the gates of all the caissons will be simultaneously lowered. Thus the closure will to a large extent obviate the period of increasing hazard as the gap narrows, which has been characteristic of previous operations of this kind. But to appreciate the method fully, a more detailed description is necessary.

The Closure Operation

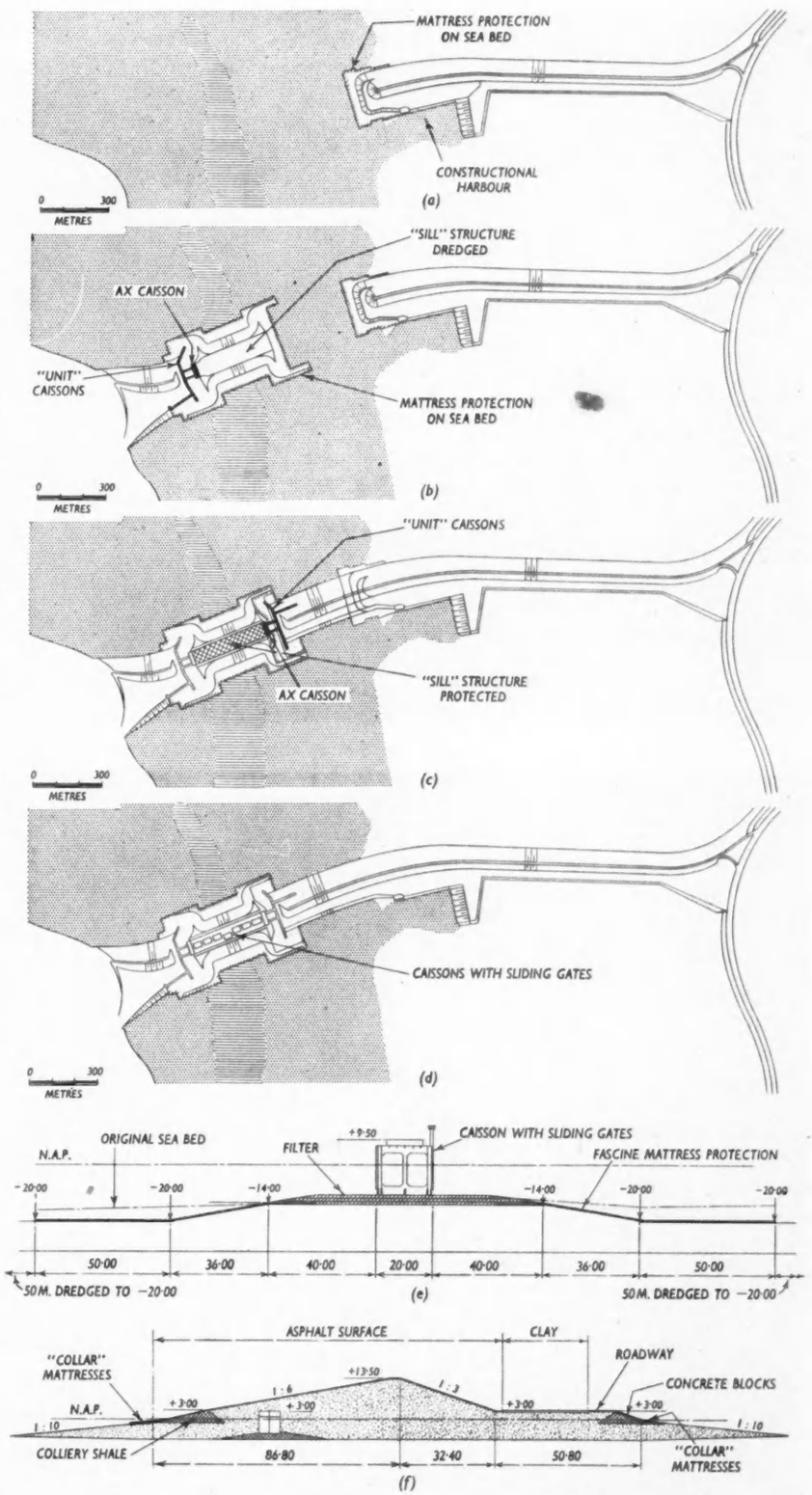
The main stages of construction can best be appreciated by reference to the series of diagrams, shown in Fig. 11. The shallows extending from the shore of Nord-Beveland were first attacked, and an embankment was built out from Nord-Beveland extending for about half the distance across the Veersche Gat, leaving the deep channel close to Walcheren unaffected. The cross-sectional dimensions of this embankment are massive, and approximate to those of the Zuiderzee dam, for it faces a very exposed sea shore. Its crest level is +13·5m N.A.P., and its surfaces are largely stabilised with asphalt, following contemporary Dutch practice. This part of the work, known as the Plaat von Onrust dam, was built in eight months. Its construction was indeed no light task, and well worth an article of its own were it a complete scheme as it now stands. However, we intend to concentrate only on the remaining section, the closure of the deep channel, where work is now in progress.

The second diagram shows the stage of construction reached this year. The site for the caissons is being prepared, while still leaving open a channel between it and the embankment. The length to be closed by the seven main caissons will be limited at each end by an " abutment " consisting of a cluster of caissons arranged in the manner shown.

One of these " abutments " is under construction this year. It comprises a " Phoenix AX " caisson of Mulberry harbour vintage set broadside on to the gap, and a number of " unit " caissons (which are much smaller) arranged behind it. The first stage of embanking is retained behind " unit " caissons parallel to the "AX" caisson. Extensive sea-bed protection then permits landing the large " AX " caisson on a level bed. The space between it and the first stage is then raised and levelled by a massive filling of colliery shale, allowing further " unit " caissons to be placed on each side of the " plateau " of shale fill to link with the " AX " caisson. The space between these latter caissons is then filled solid with stone and an embankment with protected slopes and a roadway completed above. This " abutment " construction is quite complex, involving several stages of sea-bed protection with mattresses and stone, and the use of colliery shale in various critical areas of the new embankment, such as caisson " beds " and embankment toes. The second "abutment" will be built next year, as the third diagram shows. Next year's work will also include completion of what might be called the "sill structure," on which the main caissons will rest, and closure of the channel to the east of it, by extending the embankment by normal methods of construction.

A cross section of the " sill structure " is shown in Fig. 11 (*e*). The sea bed is sandy, and is dredged to −14m over a width of 100m. The " sill " itself is formed on top of this by a mattress and stone construction 3m thick. On each side of this " sill " there is a slope down to a dredged level of −20m, this lower level extending on each side for about 100m.

Hydraulic studies indicated that this cross-



(*a*) 1958 works. Construction of Plaat von Onrust embankment. Reduction in cross-sectional area of tidal channel, 2 per cent.

(*b*) 1959 works. Western " abutment " constructed, using " unit " caissons and one " Phoenix AX " caisson. First stage of preparation of " sill structure." Reduction in area of tidal channel, about 10 per cent.

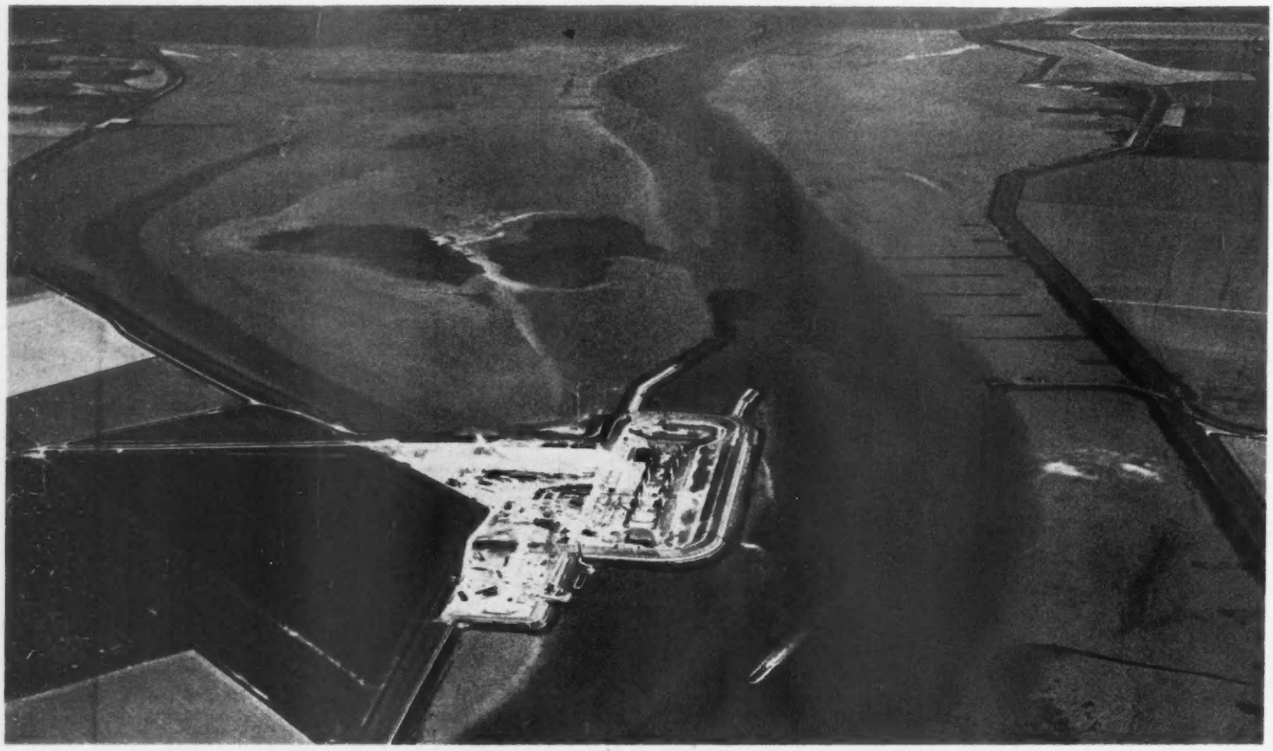
(*c*) 1960 works. Eastern abutment completed, and embankment dam completed. Sill structure made ready for caissons. Reduction in area of tidal channel, about 50 per cent.

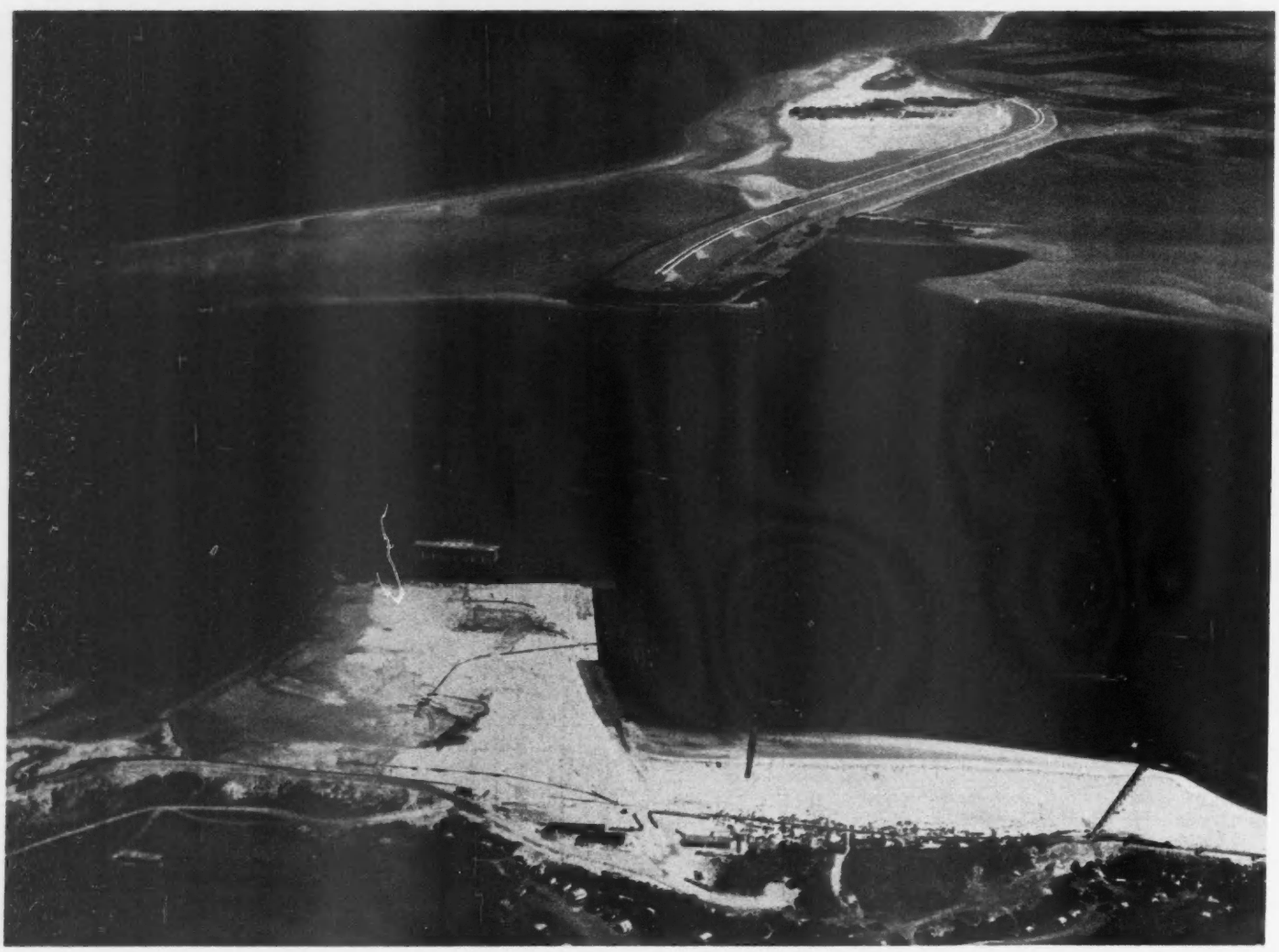
(*d*) 1961 works. The seven gated caissons are placed successively on the sill structure, and the closure is made.

(*e*) Cross section of sill structure with gated caisson in position. The filter on the sill is 3m thick and, from the bottom to the top, consists of (i) nylon mattresses ; (ii) 0·9m thickness of stone of 5mm–20mm grading ; (iii) 0·9m thickness of gravel (coarser grading) ; (iv) 0·6m thickness of dumped stone of high specific gravity ; and (v) 0·6m thickness of similar stone of coarser grading.

(*f*) The completed dam showing the sand fill surrounding the gated caissons, and other details.

Fig. 11—Stages in the construction of Veersche Gat dam





Figs. 12 and 13—Dam construction for the three island scheme. ABOVE is the cofferdam, and within it, the lock under construction, for Zandcreek dam. The closure of the main section of the dam will be made with caissons. BELOW, Veersche Gat dam. In the background is the Plaat von Onrust embankment. In the foreground, the "Phoenix AX" caisson for the Walcheren "abutment" of the main closure is in position, with unit caissons backed by filling materials inshore of it

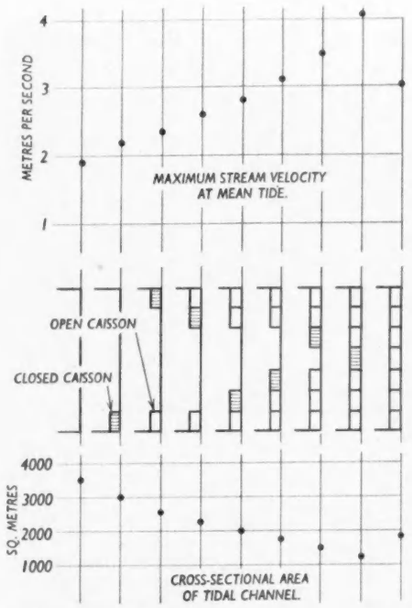


Fig. 14—Tidal velocities and cross-sectional area of tidal opening during emplacement of the seven main caissons. The final stage with seven "open" caissons leaves an opening of about 55 per cent of the original area over the sill

sectional profile would give the best results in reducing scour, since turbulence in the vertical plane is dissipated by the cushion of water in the pocket on each side of the "sill." The shape of each "abutment" of caissons was similarly studied to reduce scour in that region as far as possible, this time considering especially turbulence in the horizontal plane.

Data for tidal flow velocities are given in Fig. 14 for the various stages in placing the caissons. The maximum velocity which will occur during this stage of the work is estimated at just over 4m per second. With the refinements in hydraulic design just enumerated, this limiting velocity will be successfully resisted by the "sill" structure, some explanation of which should now be given.

The "Sill Structure"

The well-established practice in works of this kind is to cover the dredged sea bed with willow mattresses sunk into position by loading them with stone. An entirely new method is to be used here, however, for two reasons. Earlier works—particularly the Zuiderzee dam—showed that the life of willow mattresses is limited—perhaps a year can be relied on—because of attacks by marine borers. In addition, the demands of the major dams, construction of which will follow the Veersche Gat dam, combined with all the other extensive calls on this form of construction, would outstrip the supply of willow twigs.

A flexible mattress of some sort to replace the traditional willow fascine mattresses was therefore sought. The solution consists of a mesh of nylon strands, with "hoses" of nylon filled with sand spaced across it at intervals to give it weight. This mesh is to be laid by a machine which will roll along the sea bed.

Each mattress will be 17m wide by 80m in length. The sand-filled hoses stretch across the shorter dimension at 1·2m centres, and are 10cm in diameter. The machine used to lay them is illustrated. The mattress is folded on to this machine and pulled out, passing under the rollers, as the machine is towed across the sea bed. The beam of triangular cross section can be pressed against the foremost roller to hold the leading edge of a mattress in position, and is raised to allow laying to proceed. The whole machine can be lifted out of the sea by the derrick carried on the barge which controls it. When it is to be reloaded with mattresses, a beam carrying a sand hopper is placed across it, and the mattresses can be readily made. It carries 17 tons of these mattresses when filled to capacity, its total weight then being 23·5 tons.

These nylon mattresses are to be laid to cover the "sill structure" over an area of sea bed of about 200m by 320m. The "sill" itself, as we have chosen to call the flat stone bed on which the caissons will stand, will be built of several layers of stone placed on top of these mattresses. This stone construction will be permeable, with fine material on the mattresses and coarser layers above, as explained in the legend (Fig. 11 (*e*)).

The sloping areas of the sea bed on each side of the sill proper, and a 50m extent of the flat lower level beyond each of them, will be protected by the conventional fascine mattresses, built of willow twigs. These are sunk by stone laid to the extent of 250 kg per square metre, and then "heavy" stone is added, 800 kg per square metre, on the slopes and 600 kg per square metre on the "flats." This stone is generally basalt, of high specific gravity, the first layer, known as "zinksteen" in Dutch, comprising individual stones of 10/80 kg which can be handled on to the mattresses and the second layer ("stortsteen") individual stones of 60/300 kg.

With the caissons all in position, the closure will be made at slack water, as already explained, on a convenient tide. Sand will then be placed hydraulically and very rapidly, to surround and bury the caissons. Then the dam will be built to its final, very substantial cross-sectional shape, as shown in Fig. 11 (*f*).

Main Caissons

A cross-sectional view of the design now adopted for the seven main caissons is shown in Fig. 16. This design shows various refinements over earlier proposals. Since the closure will be made before the caissons have to withstand a winter, it is not necessary to allow ice to pass through them, so the sides of the caisson will be, in effect, a lattice girder with vertical and horizontal members of reinforced concrete, but with diagonal members of steel, forming a mesh at the openings. These steel diagonals will make the caisson strong in torsion. The depth of "solid" concrete wall of 3m below these grids is necessary to allow stone to be tipped along each edge of the row of caissons, to resist uplift pressure from flow passing underneath.

Note the sand ballast carried above water level. This ballast is sufficient to give the caisson lateral stability against a head on one side, when the gates are closed, and before the body of the dam has been constructed. It also allows easy access, the containers forming in effect a roadway, 14m wide, along the top of the caissons. During the positioning of the caisson, lateral trim is given by the swinging partition.

These caissons are considered to be better than earlier proposals, using flap gates. But the detailing of the sliding gate proved difficult, since reliability in operation was so important. Should one of the gates fail to close, the gap could be blocked with sandbags, or with stone and wire mesh.

Progress

The captions to Fig. 11 give the programme of construction. By midsummer of this year, the big embankment, the Plaat von Onrust dam as it is called, had been completed by placing concrete blocks at the

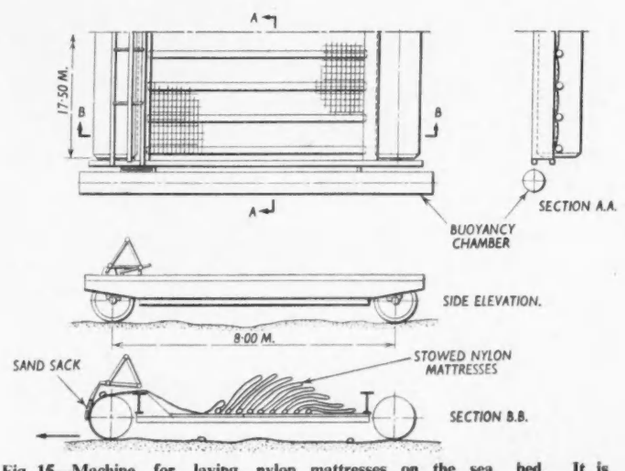


Fig. 15—Machine for laying nylon mattresses on the sea bed. It is towed along the sea bed by a special craft, with marker buoys indicating its position and the progress made

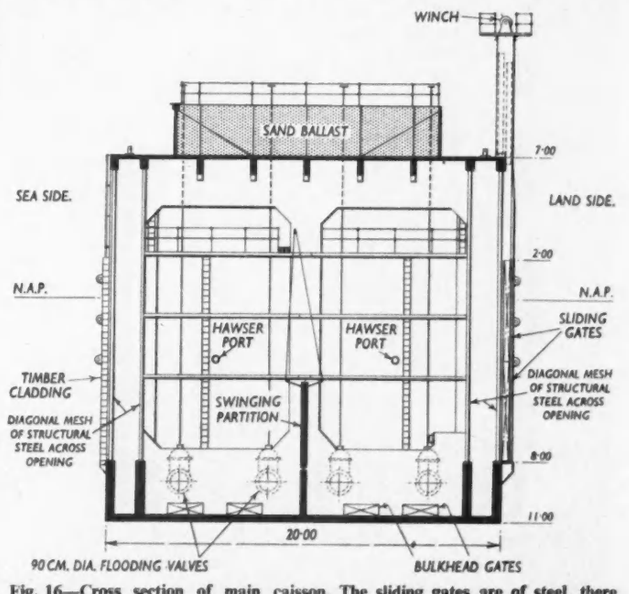
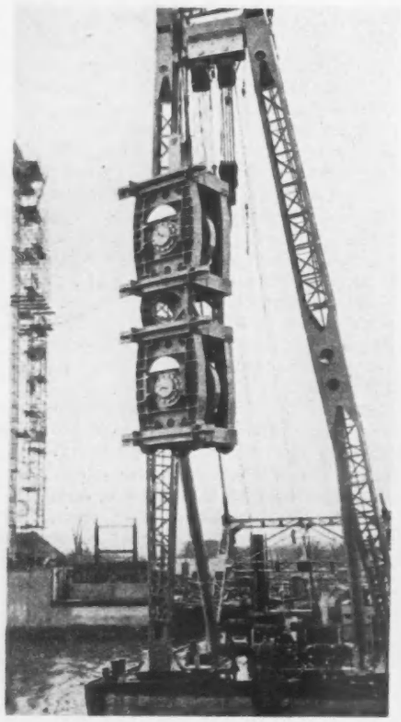
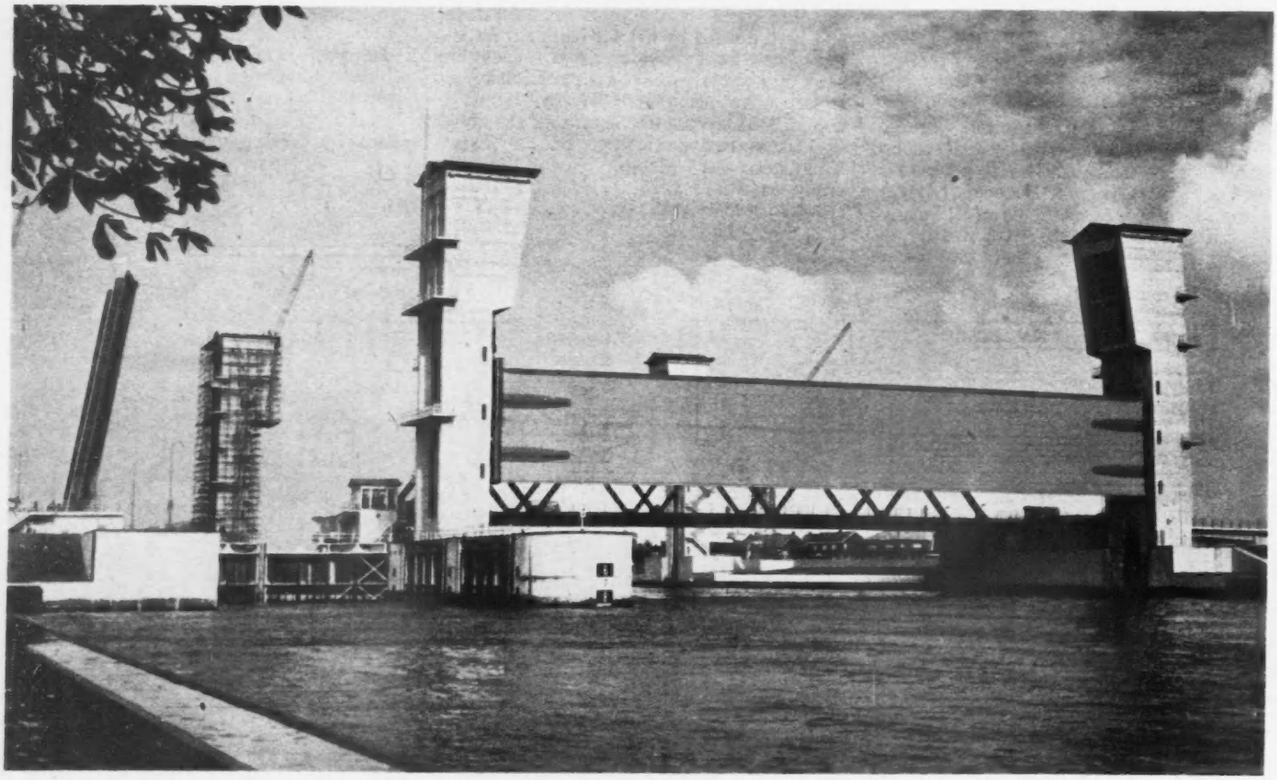


Fig. 16—Cross section of main caisson. The sliding gates are of steel, there being eight gates along the length of one caisson. The overall dimensions of the caissons are length 45·5m, breadth 20m and height 18m

Figs. 17, 18 and 19—The 80m floodgate is shown being floated into position, RIGHT. Erection of a roller train for the gate is shown in progress, LEFT. The LOWER VIEW shows the completed barrage from downstream, with the flood gate raised. Note the lock to the left, the raised bascule bridge which crosses the lock, and the fixed bridge behind the flood gate. The stand-by flood gate is not installed, but its gate towers can be seen





crest, and completing the asphalt surfacing. The western "abutment" of caissons and the large quantities of colliery shale needed in this construction, were well advanced.

Excavating the shape of the sill was also progressing, dredging to −14m N.A.P., with a deeper trench on the weather side. It was considered here that a change in the sequence of operations originally planned was needed, because the transport of sand across the flat sill appeared to be so heavy. The original plan was to place the nylon mattresses, then deepen out the weather side and place fascine mattresses of willow twigs, to protect it; and then place the graded filter layers of stone on the nylon mattresses. The modified method calls for a layer of gravel only on the flat sill; then dredging the two deeper sections and protecting them. At a later stage, the nylon mattresses can be laid on top of the gravel layer, and the filter layers then deposited.

The Delta Service's contractors for the Veersche Gat dam are, respectively, for the first stage (Plaat von Onrust embankment), Combinatie Veeregat, a consortium of four Dutch contractors, and for the second stage, N.V. Aannemingsmaatschappij "Dijksbouw." The contract sums are, respectively, nearly 6,000,000 guilders and 23,250,000 guilders. Ancillary works included the construction of quite a substantial harbour (not the harbour shown in Fig. 11) to serve the craft at work at the site, and a dock for building the caissons.

The Surge Barrier

THE structure which we now describe is of special interest because the subject of surge barriers is somewhat topical in this country. The Waverley Committee on Coastal Flooding, which reported after the 1953 disaster, recommended that a barrier should be constructed in the Thames estuary which could be closed in the event of abnormal tidal levels, thus protecting London from the possibility of damage by flooding. This recommendation was followed by a study by consulting engineers, but the Ministry of Housing and Local Government has not yet made public the consultants' report.* The barrier on the Hollandsche Ijssel is thus the only structure with this specialised function which has been constructed in recent years and to a modern design.

The significance of this new structure, which is now complete, can best be shown by referring back to Fig. 1. It will be recalled that a first line of defence against the sea is to be provided by the new dams of the delta scheme, except at the Nieuwe Waterweg, the channel serving the port of Rotterdam. As we explained in the introductory article, present plans call for raising the embankments in this area to give protection from storm surges. However, the Hollandsche Ijssel can be conveniently isolated by the barrier. This river is one of the deltaic branches of the Rhine, and it carries virtually no flow, except the pumped drainage from the polders along its banks. There is thus no problem of the river "ponding up" behind the closed gate of the barrier.

Furthermore, the river flows through the lowest part of Holland. The land surface nearby is as much as 6·3m below mean sea level. The area has been well developed for very many years, and its charm is typical of the tourists' conception of the low countries. The embankments which protect it, however, are of great age and of questionable reliability. For instance, the dyke alongside the Hollandsche Ijssel close to the new barrage carries a narrow road (at present with heavy traffic) along its crest, and houses have been built, many years ago, beside the road and on the crest of the dyke. These buildings crowd together in a manner which is picturesque, but nothing less than a nightmare for the civil engineer. The practice of building secondary dykes to enclose areas behind the first line, so that flooding would be restricted in the event of a failure, was not taken very seriously in the period when these lands were reclaimed, and these secondary dykes are somewhat sparse and irregular. The main dykes have been heightened and widened in the past and in some places soil mechanic studies have indicated they are, under normal conditions, near the limit of stability and undergoing subsidence continuously. Thus they have no reserve of strength to meet the unusual hazards of a storm surge and they cannot be heightened economically. The low-lying land extends from the Hollandsche Ijssel right through the heart of Holland to Amsterdam and the Ijsselmeer, and a breach in the embankment here could cause flooding over that entire region.

Breaches and flooding were, in fact, experienced along these banks (the Lek also breached its bank but not seriously) in 1953. Two breaches were formed which would have been subjected to tidal scour if allowed to develop, but repair work was undertaken with extreme rapidity. Deepening of the Nieuwe Waterweg in recent years has been a factor which has rendered this area more vulnerable to flooding from tidal surges than in the past.

High tides in the river around Rotterdam generally reach a level of +1·0m to +1·3m N.A.P. The surge gate is closed if the tide rises to somewhere around +2·5m N.A.P., depending on the weather forecast.

Construction of the barrier was started in November, 1953, and completed last year except for the installation of the stand-by gate. It consists essentially of an enormous gate, with a similar stand-by gate behind it, which can be lowered into the river to close it completely against excessively high tides. There is also a lock, so in the event of very high levels on the seaward side, the lock would function and navigation would not be interrupted. The principal dimensions, and other data for the barrier, are given in Table V.

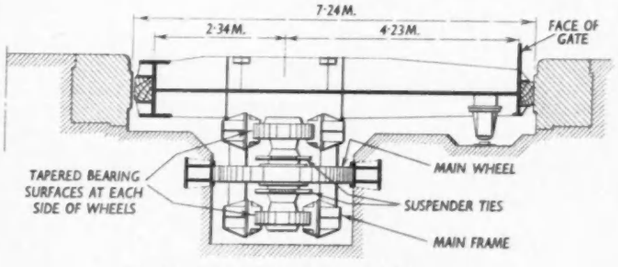


Fig. 20—Detail at gate groove of flood gate

TABLE V—*The Hollandsche Ijssel Surge Barrier*

Main Gates

Number of gates	2
Width of gates	80m
Sill level	−6·5m N.A.P.
Top level of gate in closed position	+5m N.A.P.
Bottom level of gate in raised position	+12m N.A.P.
Top level of gate towers	+44·75m N.A.P.
Weight of gate:	
Weight of leaf	620 tonnes
Weight of two roller assemblies, each	60 tonnes
Total	740 tonnes
Number of counterweights for each gate	2
Weight of each counterweight	280 tonnes
Structural "depth" of gate stiffening truss	14·815m
Structural "depth" of gate stiffening truss as fraction of span	2/11
Thickness of steel plate skin of gate	12mm
Time taken to close gate	30 minutes

The Lock

Effective length	120m
Width at entrance	24m
Sill level	−5·2m N.A.P.
Low water level	−0·6m N.A.P.
Cope level	+6·0m N.A.P.
Top level of gates	+5·0m N.A.P.
Number of lock gates	10

Overall cost of surge barrier, 40,000,000 guilders.
N.A.P.—Mean sea level, Amsterdam datum.

The basic ideas behind the design of the barrier were to alter the existing cross-sectional area of the river at the site as little as possible, and so to maintain unaltered the existing tidal cycle, except in the case of an exceptional surge when one or both of the main gates would be closed. It was also required that as little hindrance as possible to shipping should be caused by the barrier, and shipbuilding activities upstream of it were one of the factors considered. The Hollandsche Ijssel has a tidal area of around 300 hectares, and a normal tidal "cubature" of 5,000,000 cubic metres. This is not altered by the barrier, the maintenance of the normal tidal cycle also assisting water supply further up the river, since fresh water from the Lek is carried up the Hollandsche Ijssel on the flood tide.

The barrier includes a road bridge in two sections—a bascule bridge over the lock, and a fixed bridge over the main span—and a major road improvement close by was incorporated into the constructional scheme.

Foundation conditions at the site were poor with reasonably good sand at depths of −17m to −21m N.A.P. Thus extensive piling was needed to carry the main structures. The main gates can withstand a water load on either face, and the various river and lock walls have to withstand hydrostatic loads from the river, or, alternatively, pressures from retained sand fill, so the foundation piling took the form of main groups of piles, each with vertical load-bearing piles and rakers in four directions to cater for the alternative loading conditions. A pile of 35cm square cross section carries a load of about 50 tons. The mean length of the piles is 11m; the total linear quantity of piling in the main work is about 33km.

The walls of the centre part of the lock and the corresponding lengths of river wall are built with anchored steel sheet piling with a concrete coping. Where the gate towers and gate recesses of the locks are situated, however, the structure above pile level is in cellular reinforced concrete, filled with sand, the outer walls of these cellular constructions forming the gate recesses in the lock, and corresponding lengths of the river wall. Thus the principal structural loads are concentrated in block-like structures at each end of the lock, and under the gate towers on the left bank, and it is these cellular blocks that are carried by the piling.

The lock gates are mitre gates of welded

*Two consulting firms—Messrs. Rendel, Palmer and Tritton, and Sir Bruce White, Wolfe Barry and Partners—prepared reports on the practicability, design and estimated cost of such a barrier. In Parliament on February 24, the Minister said that he had received reports from these firms and was arranging to publish a summary of their views and conclusions. He promised a further statement to the House. This is still the position.

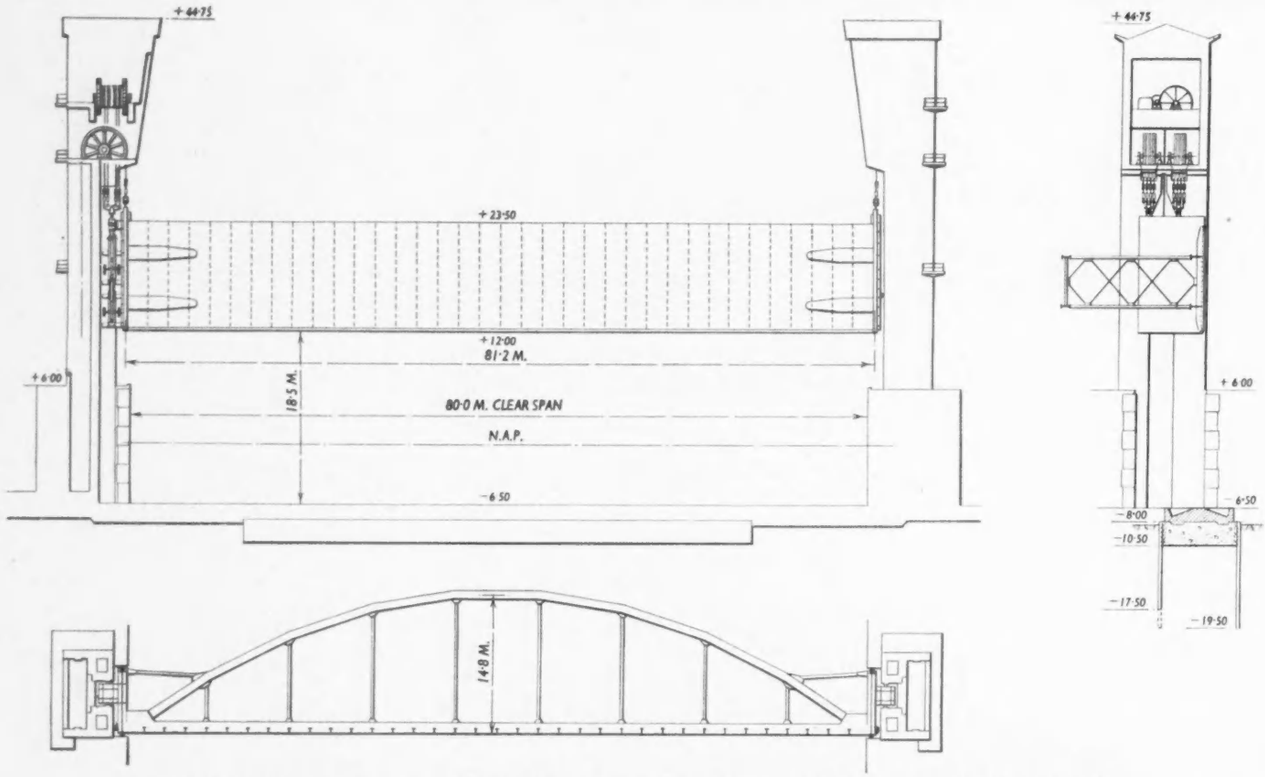


Fig. 21—General arrangement of flood gate of 80m span, showing the structure of the gate, the towers, and the gate sill

steel, with sluice valves incorporated in them, and with rubber seals. Two pairs of gates are installed at each end of the lock, one pair facing each direction (since a head may be withstood on either side of the barrier), and there is an additional pair of gates at the head of the lock facing towards the sea. Normally, one pair of lock gates is kept closed. All gates are interchangeable. The dimensions of the lock were chosen to allow the passage of a ship 500ft by 70ft by 13ft draught and of unlimited height, but such a ship would have to pass (its frequency is one a year) with all the lock gates open, for the length of the lock has been kept down to the dimensions of the Juliana lock further upstream near Gouda. Repair of gate sills and recesses can be done with limpet cofferdams.

The 80m span of the road bridge is a steel Warren girder of 10m structural depth, and the span has a stiffened steel deck of 10mm plate. The bascule bridge is also in steel.

Main Gates and Gate Towers

The accompanying drawing shows one of the main gates and its towers. As can be seen, the form of the gate is similar to a Vierendeel truss, but in this case the water load can be applied in either direction. Furthermore, the skin plating contributes substantially to the stiffness of the whole structure and giving a worthwhile reduction in weight. The structural behaviour between the skin and the main members is orthotropic. Note the two substantial steel plate stiffeners, perpendicular to the skin of the gates, which distribute the loads at each side of the gate on to the rollers or the gate towers, and which also carry the counterweight ropes. Each of these plates runs in a recess in the gate tower, at each edge of which the gate may be sealed. Design of the gate is in riveted and welded mild steel, and the maximum design loading is for a head of 4·5m acting on either side of it. The counterweights weigh 560 tonnes, and the gate and rollers 740 tonnes. The unbalanced weight is necessary to close the gate completely against adverse hydraulic conditions.

The gate is moved on steel rollers carried in recesses in the gate towers. The winches are electrically-operated, as are all the mechanisms of the barrier. The two winches have a total horsepower of 50 at 1500 r.p.m. and the gate is moved at speeds of 2cm per second when travelling in air. When in water, the corresponding figures are 16·6 h.p., 500 r.p.m., and $\frac{2}{3}$cm per second. Opening or closing takes thirty minutes. The gate towers each consist structurally of two interconnected r.c. columns, one steel guide rail being fixed into each column.

Another original design feature which the drawing shows is the shape of the gate sill. This was determined from model tests, at Delft University, the object being to reduce scour in the river bed when the gate is partially open. The gate bears on the top of the "saddle" and the two nearly vertical slopes on each side of the saddle are faced with steel.

It is thought that its size and duty makes this gate an advance on previous practice.

Roller Assembly

The roller assembly is constructed to "crack open" the gate against a water load acting on either side of the gate. This assembly is shown in cross section in Fig. 20, and in the photograph reproduced in Fig. 17 The steel frame carrying the assembly and shown in the latter illustration is mounted solidly on to the gate structure of which it forms a part. Note that there are two main wheels in the assembly, each with a pair of subsidiary wheels carried on the same shaft. The two main wheels are each 2·25m in diameter, and the four subsidiary wheels each 1m in diameter ; they all have self-aligning bearings. These wheels are suspended freely on ties from the top of the assembly, the ties being pinned between the two shafts to ensure free suspension for the lower one. The lifting cables are attached to a crosshead. The tie bar assembly hangs from this crosshead, passing through a massive bracket in the main structure. A stop on the tie bar assembly brings it solidly into contact with the bracket, the stop having a clearance of 400mm when the gate and tie assembly are lowered. The main wheels have a small clearance between the two rails in the gate groove. The subsidiary wheels are enclosed by tapered bearing surfaces fixed to the main frame of the assembly, and tapering at 1 in 10, narrowing to the top.

When the gate is down, with water load against one side, the wheels hang freely on the ties. In the first stage of lifting, tensioning the lifting cables starts to lift the tie bar assembly which rises by about 75mm. This is sufficient to bring the subsidiary wheels into contact with the tapered bearing surface on the side from which the water load is acting (i.e. since the gate is sealed by the water load, it and the tie assembly will not be on the same centre line). Further raising of the tie bar assembly up to the maximum of 400mm tends to force the main wheel against the gate rail on the side remote from the water load, and to unseat the gate (i.e. the gate moves towards the water load), due to the reaction between the subsidiary wheels and their tapered bearing surfaces. The gate is then "cracked open," and, since the stop is abutting against the bracket, the main wheels become operative to lift the gate.

The gate has a clearance of 80mm between the two seals. The main wheels have a clearance of 10mm between the two rails. With the gate raised 75mm, and each subsidiary wheel just in contact with the corresponding tapered surface on the water load side, the clearance from the wheel to the other surface is 70mm.

Design of the surge barrier was in the hands of the Rijkswaterstaat and the main contractor was Christiani and Nielsen N.V., of the Hague. The firm which built and installed the 80m flood gate was Penn and Bauduin.

The aerial photographs reproduced in Figs. 2, 8, 9, 10, 12 and 13 were taken by K.L.M. Aerocarto of Amsterdam.

Traction Equipment for 50 c/s Trains

The multiple-unit trains now running on the Colchester–Clacton–Walton section of the Eastern Region, British Railways, are formed of the first rolling stock built and equipped in this country for the 25/6·25kV, 50 c/s electrification system. This article describes the traction control equipment, which represents the first major application of a rectifier system to motor-coach stock, previous development in this form of traction on the Continent having been concerned mainly with locomotives.

BEFORE the opening of the Colchester–Clacton–Walton high-voltage a.c. electrification in the Eastern Region of British Railways on April 13 this year (see our issues of April 17 and 24, 1959), the only rolling stock operating revenue-earning services on the single-phase, 50 c/s electrification system in this country consisted of former d.c. motor coaches and trailers running between Lancaster, Morecambe and Heysham in the London Midland Region. In these vehicles the d.c. traction control equipment had been carried in the coach bodies, and the same arrangement was continued after conversion to alternating current. It was convenient for experimental purposes, apart from which the coach underframes were not designed for the attachment of equipment cases. Public services on the Lancaster–Morecambe–Heysham line with the converted trains began on August 17, 1953, since when considerable development of equipment has taken place and designs of rectifiers, transformers and control gear suitable for underframe-mounting have undergone service trials, although in the main necessarily carried inside the coaches at that stage.

The trains now running on the Colchester–Clacton–Walton line are the first of the 112 four-car units being built at York and Doncaster for eventual use on the London, Tilbury and Southend electrification from Fenchurch Street. They are the first to be built by British Railways for a.c. working, and to carry complete underframe-mounted traction equipments with provision for running on the two overhead line voltages (25kV and 6·25kV) characteristic of the British Railways 50 c/s electrification scheme. A brief account of the traction equipment appeared in our issues mentioned above, and we are now able to amplify the particulars then given by courtesy of the manufacturer, The English Electric Company, Ltd. This company's equipment for the first Lancaster–Morecambe–Heysham 50 c/s a.c. trains, mentioned above, was described in our October 9, 1953, issue.

The normal train unit consists of four coaches—a battery driving trailer, a motor coach, a non-driving trailer and a driving trailer. The main traction equipment is carried on the motor-coach underframe but the adjacent driving trailer carries the battery, the main compressor and the rectifier unit for battery charging and compressor drive. This vehicle is therefore called the "battery driving trailer" to distinguish it from the driving trailer at the other end of the unit.

Power Circuits

Current is supplied to the motor coach through a Stone-Faiveley pantograph and a Brown-Boveri air-blast circuit breaker, both of which were described in our April 24 issue. The connection between the air-blast circuit breaker and the transformer is made by a h.t. through bushing to an oil-filled junction box below the floor, and thence to the transformer by a h.t. flexible cable having condenser bushings at each end.

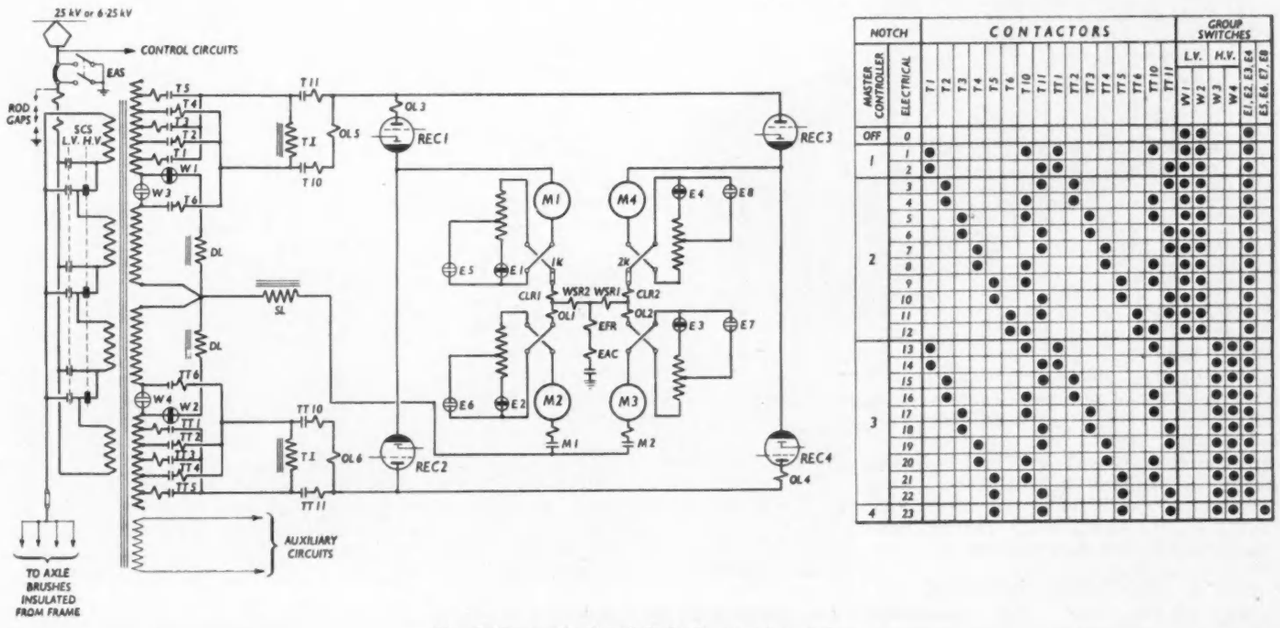
Referring to the power circuit diagram (Fig. 1), the primary winding of the oil-cooled, underframe-mounted transformer is in four sections, which are connected in series on 25kV or in parallel on 6·25kV by the changeover switch *SCS*, mounted on the transformer tank. This operation takes place automatically, according to line voltage, under the control of voltage-sensitive relays fed from a capacitive potential divider. The line voltage detector unit containing the voltage-sensitive relays is housed in the auxiliary cupboard in the guard's van, and the potential divider is mounted on the coach roof.

The secondary winding consists of two sections connected so as to form a centre-tapped symmetrical winding, the two motor circuits being returned to this centre-tap through smoothing reactor *SL*. A tertiary winding supplies auxiliary machines and services at a nominal 240V.

Each pair of rectifiers is connected as a bi-phase pair supplying two traction motors in series. The rectifiers are steel tank, single-anode, mercury arc excitron units, and are mounted in underframe cases (Fig. 2), each housing two rectifiers with their control equipment, heater and a 240V, single-phase, 0·75 h.p., capacitor-start-and-run fan motor. Thermostats in each case detect the main rectifier temperature, and if this is too low for load-carrying one thermostat causes the excitation to be cut off, the heater to be switched on, and the fan motor to be switched to low speed. Excitation is re-established when the temperature reaches a safe value, and on its attaining a value nearer to normal operating temperature a second thermostat operates to cause the heater to be cut off and the fan to run at high speed.

Should a rectifier reach a temperature too high for satisfactory operation, a third thermostat causes excitation to be cut off from both rectifiers of the pair and the traction current to all four motors to be interrupted. In these circumstances the rectifier fan will, of course, already be running at high speed, and the heater will be off, these conditions having been established by the second thermostat on the approach to normal operating temperature as described above.

An equalising connection is provided between the mid-points of the two parallel motor circuits. The equalising connection includes the two wheel-slip relay windings, *WSR*1 and *WSR*2. If an axle slips, there will be a potential difference between the two circuit mid-points so that current will pass through the relay windings. Relay *WSR*1 detects relatively low equaliser currents which are associated with wheel "creep," and operates to halt the notching



NOTCH		CONTACTORS												GROUP SWITCHES					
														L.V.		H.V.			
MASTER CONTROLLER	ELECTRICAL	T1	T2	T3	T4	T5	T6	T10	T11	TT1	TT2	TT3	TT4	TT5	TT6	TT10	TT11	W1	W2	W3	W4	E1, E2, E3, E4	E5, E6, E7, E8
OFF	0																	●	●				
1	1	●						●		●							●	●	●			●	
	2	●						●	●	●								●	●			●	
2	3		●					●	●	●								●	●			●	
	4		●					●		●	●						●	●	●			●	
	5			●				●		●	●							●	●			●	
	6			●				●		●		●					●	●	●			●	
	7				●			●		●		●						●	●			●	
	8				●			●		●			●				●	●	●			●	
	9					●		●		●			●					●	●			●	
	10					●		●		●				●			●	●	●			●	
	11						●	●		●				●				●	●			●	
	12						●	●		●					●		●	●	●			●	
3	13	●						●		●							●			●	●	●	
	14	●						●	●	●										●	●	●	
	15		●					●	●	●										●	●	●	
	16		●					●		●	●						●			●	●	●	
	17			●				●		●	●									●	●	●	
	18			●				●		●		●					●			●	●	●	
	19				●			●		●		●								●	●	●	
	20				●			●		●			●				●			●	●	●	
	21					●		●		●			●							●	●	●	
	22					●		●		●				●			●			●	●	●	
4	23					●		●						●			●			●	●		●

Fig. 1—Power circuits of dual-voltage motor coach

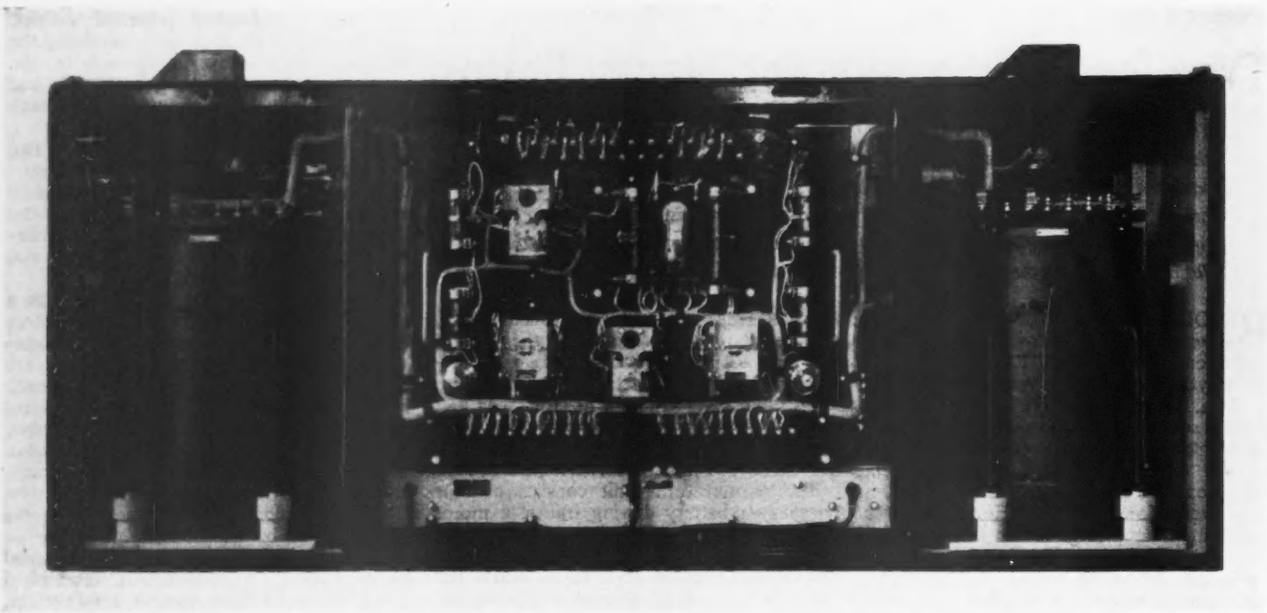


Fig. 2—Underframe equipment case containing two single-anode rectifiers for supplying two traction motors connected in series

progression to allow the slipping wheel to recover. Relay *WSR*2 detects higher equaliser currents associated with wheel "spin" and operates to cut off power, thereby ensuring recovery of the slipping wheel. In either case the equipment notches up automatically after correction of wheel slip has occurred.

The mid-point of the equalising connection is connected to earth through earth fault relay winding *EFR* and earthing contactor *EAC*.

The traction motors are conventional four-pole, d.c. machines with a one-hour d.c. rating of 274 h.p., 620V, 350A. Their fields are tapped for a single stage of field weakening which is initiated automatically in the appropriate conditions by current limit relays *CLR*1, *CLR*2, when the controller handle is in its weak-field position.

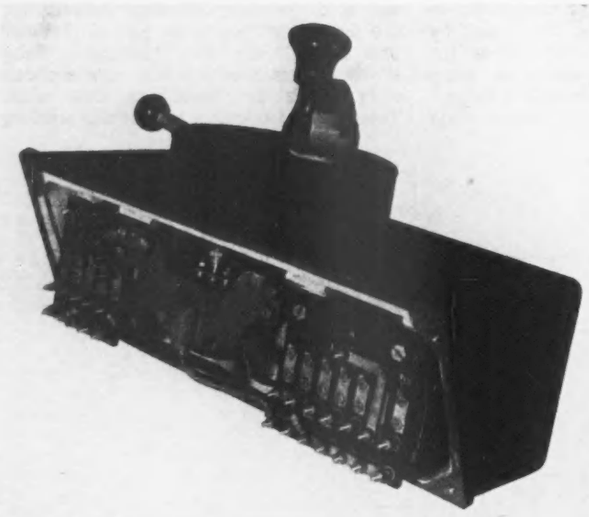


Fig. 3—Master controller with horizontal camshaft gear-driven from power handle

Tap-Changing Scheme

Tap-changing on the transformer secondary is effected by individual electro-pneumatic contactors, *T*1 to *T*6 and *TT*1 to *TT*6, under the automatic control of the current limit relays. Both series of contactors are used twice in the notching sequence by the automatic operation after the twelfth notch of the winding group switch *W*.

It will be seen from Fig. 1 that from notches 1 to 10 only the outer portions of each secondary winding section are in circuit, contactors *T*6, *TT*6 and group switch contacts *W*3, *W*4, being open. After the voltage applied to the rectifiers has been increased as far as possible in these conditions, the untapped portion of the winding is switched in by the closing of *T*6, *TT*6, giving a further step of increased voltage, followed by the closing of *W*3, *W*4 and the restoration in steps of the tapped portions until the whole of the secondary is in circuit. By this means a total of twenty-two voltage steps is obtained with the use of sixteen contactors.

The tapping reactors *TI* serve a dual purpose during tap changes. First, they prevent short circuiting of the transformer winding between the tappings concerned. Secondly, they provide intermediate notches, because immediately after a main tapping contactor has opened they remain in circuit with the next higher transformer tapping so that the voltage drop across them results in a lower output voltage than that of the tapping itself. The next step is to cut out the tapping reactors and so obtain the full transformer tapping voltage. These operations are carried out by contactors *T*10, *T*11, *TT*10, *TT*11. On steps 1 to 12 the dropping reactors *DL* are in circuit and serve to steepen the notching curves.

The driver's controller (Fig. 3) is of conventional motor coach form, but shallow in depth to match the cab layout, the camshaft being horizontal and gear-driven from the power handle. The four power positions enable the motorman to select running conditions similar to those provided by the shunting, series, parallel and weak-field positions of a d.c. motor-coach controller.

All the reactors are housed in a single tank (Fig. 4) on the motor-coach underframe, with its oil cooling circuit in series with that for the main transformer (Fig. 5). The other cases on the motor-coach underframe are the two rectifier cases (mentioned already); two a.c. cases containing the electro-pneumatic tapping contactors and group switch *W*, with associated relays and protective devices; and a d.c. case containing two traction motor reversing switches, a single field tap switch controlling all motor fields, and the motor contactors. All the switchgear is electro-pneumatic in operation. The reverser, field tap switch and secondary group switch consist of cam-operated contact groups.

Auxiliary Services

In addition to the rectifier fan motors mentioned already, the other auxiliary machines in the motor coach consist of one

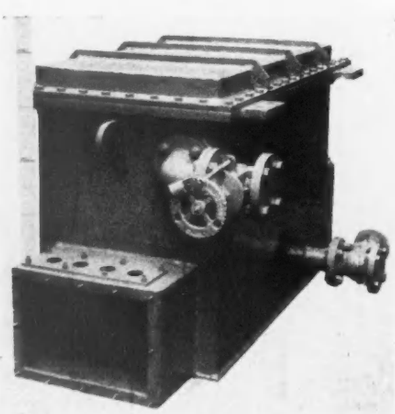


Fig. 4—Tank containing motor coach reactors

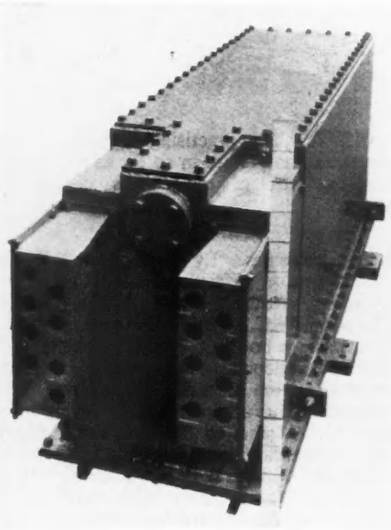


Fig. 5—Motor coach transformer

1·5 h.p. d.c. motor driving an auxiliary compressor, taking its supply from the battery in the adjacent battery driving trailer, and two 1·5 h.p. single-phase capacitor-start-and-run motors driving the transformer oil radiator fan and the transformer oil circulating pump. These a.c. machines are operated from the transformer tertiary winding and are carried under the coach, the radiator fan motor being mounted on the frame of the radiator, which was supplied by the Spiral Tube and Components Company, Ltd. The transformer oil pump motor drives a Worthington-Simpson pump, some of the oil from which is diverted through the motor frame so that the rotor runs totally immersed in oil.

The function of the Westinghouse auxiliary compressor is to supply air to the pantograph, air-blast circuit breaker and supply changeover switch on initially preparing a unit for duty, and also to close contactor *EAC* to ensure that the d.c. motor circuit is earthed before the main circuit breaker can close. If the battery should be too far discharged to obtain sufficient air for these purposes, a stand-by is provided in the form of a high-pressure air bottle.

A seventy-two cell nickel-cadmium "Nife" battery of 80 Ah capacity is mounted on the battery driving trailer underframe.

The d.c. power supplies required for the compressor motors, battery charging, control circuits and train lighting circuits are provided by a specially developed rectifier equipment manufactured by the Westinghouse Brake and Signal Company, Ltd. This equipment comprises two independent electrical circuits, the components of which are housed in one framework, designed to fit into one bay of the coach underframe (Fig. 6). One circuit consists of a single-phase, full-wave, bridge-connected rectifier only, which provides a nominal 200V at 32A d.c. to the Westinghouse CM.38 compressor motor. The other circuit consists of a single-phase, transductor-regulated rectifier with the d.c. output voltage controlled within limits of 1 per cent by means of a "Westamag" magnetic controller. It is designed to supply 110V at up to 73A for charging the battery and supplying coach lighting, control circuits, and indicating marker lamps.

Both rectifier circuits obtain their a.c. supply from a nominal 240V, 50 c/s single-phase tertiary winding on the main 25/6·6kV transformer and are subject to wide voltage variations between 176V and 314V. The construction is novel in that the two sides of the equipment consist of edge-mounted aluminium extrusions within which are mounted the selenium rectifier elements, potted to give complete protection from atmosphere. The rectifiers are electrically isolated from, but thermally in contact with, the extruded side members which are finned on the outside to help dissipate losses. Within the framework the transductor and "Westamag" controller are robustly constructed and finished to withstand the arduous conditions of underframe mounting. Natural air cooling is employed, assisted by through draught when the train is in motion.

Weights and other details of a four-car train are tabulated below :

Laden weight of four-car train	176·8 tons
Unladen weight of four-car train	152·8 tons
Weight of electrical equipment of four-car train	22·1 tons
Unladen weight of motor coach	54·4 tons
Lightest static axle load of unladen motor coach	13·0 tons
Rate of acceleration on level tangent track	1·1 m.p.h.p.s.
Average accelerating tractive effort per motor	5570 lb
Rating of traction equipment at wheels on average line voltage	765 h.p. (continuous)

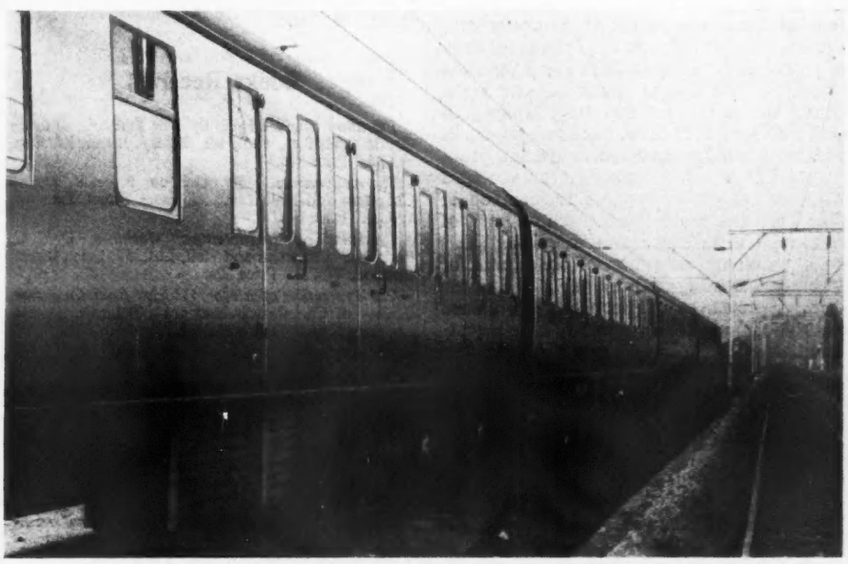


Fig. 6—Train of 50 c/s rolling stock showing in foreground battery driving trailer with underframe-mounted selenium rectifier equipment for auxiliary services

Submarine Telephone Cable Between U.S.A. and Europe

THE new submarine telephone cable system between the United States of America and France was formally opened for service on September 22, 1959. It is owned jointly by The American Telephone and Telegraph Company, the French Ministry of Posts, Telegraphs and Telephones and the German Federal Ministry of Posts and Telecommunications. This new installation is of the same design as the first transatlantic telephone cable laid in 1955 and 1956 between the United States and England, and provides for upwards of thirty-six simultaneous conversations. The total cost of the system is about 40,000,000 dollars.

It will be recalled that the Bell (A. T. and T.) system telephone network connects with the transoceanic circuits at Portland, Maine. From that point traffic passes by radio relay to Sydney Mines, Nova Scotia, and thence across Cabot Strait to Terrenceville on the west coast of Newfoundland, by a single submarine cable. A cable across Newfoundland carries the circuits to Clarenville on the east coast, for the main crossing to Penmarch in France by twin cables which lie about 20 miles apart at a maximum depth of about 3 miles. Of the thirty-six voice circuits provided by the new system, thirteen are terminated in Paris, thirteen in Frankfurt, the remaining ten in other European countries. The main part of the new cable is 2400 miles (2100 nautical miles) in length.

Manufacture of the cable was shared by four companies, namely, Submarine Cables, Ltd. (owned jointly by Siemens and Telcon) at Erith, Kent, England, responsible for 2200 nautical miles ; Cables de Lyon, 1000 nautical miles at Calais, France ; Norddeutsche Seekabelwerke, 1000 nautical miles at Nordenham, Germany, and Simplex Wire and Cable Company, 700 nautical miles at Newington, New Hampshire, U.S.A.

The inner core of the cable consists of polythene extruded over a central copper conductor composed of a 0·131in wire surrounded by three tapes 0·0145in thick. Over this core, which is 0·62in diameter, is applied the outer conductor consisting of a layer of six copper tapes applied with a long lay and held in position by a copper binder tape and a protective fabric tape, both applied with a short lay. The jute serving, galvanised steel armour wires and the outer protective serving depend on the depth and sea bed conditions in the locality of laying. For the deep sea cable, a layer of twenty-four high-tensile steel armour wires, each 0·086in diameter is used. Overall diameter of the deep sea portion of the cable is 1·2in.

The deep sea amplifiers were made by the Western Electric Company, Ltd., at Hillside, New Jersey. There are fifty-seven repeaters in each of the twin cables spaced at about 38 nautical mile intervals. Each amplifier employs three thermionic tubes and about sixty other components housed in a flexible copper tube about 8ft long and 1¾in diameter. The repeaters have a life expectancy of at least twenty years. The single cable between Sydney Mines, Nova Scotia and Clarenville, Newfoundland, has sixteen repeaters of British Post Office design for two-way operation. The internal units for these repeaters were manufactured by Standard Telephones and Cables, Ltd., while the housings were produced by Submarine Cables, Ltd.

The new cable was laid by the British Post Office cable ship H.M.T.S. "Monarch" and cable ship "Ocean Layer" which belonged to Submarine Cables, Ltd.

LITERATURE

Book Reviews

Elements of Materials Science. By LAURENCE H. VAN VLACK. Addison-Wesley Publishing Company, Inc., 10–15, Chitty Street, London, W.1. Price 49s.

ALTHOUGH it is described as an introductory text for engineering students this book covers 528 pages. These include more than that number of illustrations, eight pages of contents list, and fourteen pages of index. The author is Professor of Engineering Materials and Metallurgy at the University of Michigan, where he teaches the unusual combination of introductory courses in engineering materials, and advanced courses in ceramic materials and process metallurgy. He designed this book to be especially valuable for engineering students who possess a background knowledge of general physics and chemistry. His approach to the subject is based on his research activities with non-metallic aspects of process metallurgy, such as refractories, slags and inclusions. He has thus integrated the study of metallic, ceramic and polymeric materials in teaching undergraduates the science of engineering materials.

Having studied in U.S.A. universities and having been employed in U.S. steel works, it is natural that his choice of words is not always what would be used in Great Britain. Sometimes it appears to be a rather long-winded form of word saving ; for example, " Chapters 2 through 15 " and " Chapters 11 through 15 " could well be Chapters 2–10 and Chapters 11–15. Similarly, use is made of a system of index references in which numbers refer to pages in the text and capital letters refer to the appendices. The value of this novel idea is at least questionable when the appendix has more than one page, and there are no less than 14 pages in Appendix B.

There are many examples in the wording used by the author which will jolt British engineers and metallurgists. One such is where Sorbite is defined as " Martensite tempered to give intermediate carbide agglomeration (archaic)." That last word is, to say the least, unexpected, because Dr. Sorby, after whom the material is named, was working with his microscope less than a century ago ! Then our old friend eutectic is defined thus :—

" Eutectic (Binary)—A thermally reversible reaction :

$$\text{liquid} \xrightarrow[\text{heating}]{\text{cooling}} \text{solid}_1 + \text{solid}_2."$$

That is certainly not what a metallurgist or an expert in slags or glass making would expect to read, if he had been brought up to recognise the appearance of eutectics under the microscope, and their significance in the melting shop. It is, however, a useful way of relating particular materials and observed facts to broadly based principles for to-day's students and tomorrow's engineers.

The first chapter sets before the student typical engineering materials and terminology. The next eight chapters bring to his notice known details of the internal structures of materials, passing from atoms to crystals, to phases, to microstructures and macrostructures, because that is the logical approach. The third and final group of chapters study the behaviour of materials in service. Here are described mechanical stresses, thermal reactions, corrosion, electromagnetism and radiation, as they affect materials in various conditions of use.

The author has clearly been at pains to make his book of help to his students and one may commend, for example, the way in which he has annotated the references, which are placed at the end of the chapters. Reading these one is told whether they are of an introductory character, of a popular nature, or whether they are only for the advanced student and instructor. As would be expected the references are mainly to United States literature. The book being primarily intended for students, worked-out problems and also problems for homework are included : this is, however, a volume which many older engineers would find useful and be glad to possess.

Automatic Process Control. By DONALD P. ECKMAN. John Wiley and Sons, Inc., New York, and Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 72s.

THE author previously published a similar book which at the time, in 1945, was considered to be a classic. At that time he was employed by a large instrument company in America. Professor Eckman is now, and has been for some time, back in the academic sphere and as a consequence this later book is much more academic in its approach. It is, however, still useful to both the practising engineer and the advanced student. A knowledge of both mathematics and dynamics up to advanced undergraduate level is essential in order to take full advantage of the book.

The early chapters of the book cover the basic approach to the automatic process control problem. They start with the consideration of process characteristics and advance through the general principles of closed loop automatic control and the feed-back measuring elements which make this possible. Automatic controllers of pneumatic, hydraulic and electronic types are discussed in general principle, together with some extremely useful schematic diagrams of some of the well-known forms these equipments take. Finally, regulating units receive the same treatment. In all these chapters the basis of investigation and explanation is mathematical. The author then describes the instrumentation of processes purely theoretically and avoids consideration of any particular kind of process. This approach to the problem is typical of the earlier parts of the book where the author is obviously aiming at giving a sound base of fundamental principles without becoming involved in specific problems. The last two chapters are concerned with the analysis of systems, the method of doing the analysis being the simple form of sinusoidal disturbance and response. This does permit the definition of conditions for stability, including both the Nyquist and the Bode approach to the problem. Contained in each chapter of the book are an adequate number of examples which are worked out in detail. Then approximately ten problems are set at the end of each chapter to test the reader's appreciation of that chapter. The answers to the problem are given at the end of the book, together with other useful appendices, such as automatic control definitions.

It seems a pity in such a comprehensive book that no section of it is devoted to analogue techniques. Particularly from a mathematical point of view, this would have been a very easy step to have taken and would, for the practising engineer, have completed the picture in so far as this rather complex problem of process control is concerned.

Basic Electronics. By J. DALY and R. A. GREENFIELD. Heywood and Co., Ltd., Carlton House, Great Queen Street, London, W.C.2. Price 45s.

How basic a book on " Basic Electronics " should be depends, more than in most subjects, on the readership for which it is intended. The present volume is one of a series for entrants to the chemical industry and, while assuming an understanding of the elementary properties of electricity and magnetism, the authors open with three chapters on direct current, magnetism and alternating currents. In subsequent chapters, also, when thermionic valves and circuits are discussed, they necessarily include a fairly high proportion of material to be found in handbooks on radio, although early opportunities are taken to introduce devices and methods peculiar to electronic as distinct from communications practice, such as cold cathode valves and relaxation oscillators. The treatment is well designed for the newcomer to these subjects and will make the book useful to many outside the chemical industry (and perhaps even in the electrical industry itself) who find themselves confronted with electronic apparatus. The authors do not confine themselves to purely electronic apparatus where other techniques are its logical complement, and for this reason a section on magnetic amplifiers is included. The elements of cold cathode gating and ring counter circuits are described, and the final chapters deal with semi-conductors, power supplies and the application of photoelectric and other input/output devices to certain forms of instrumentation. The field of electronics is so wide that many more than the 226 pages of the present volume would be required to answer all the questions that newcomers may ask, and to cover all the varieties of practice that may be met. Such books, however, serve little purpose for readers lacking the sound grounding of knowledge which this volume will enable them to acquire.

Books Received

Vibration Engineering. By Ker Wilson. Charles Griffin and Co., Ltd., 42, Drury Lane, London, W.C.2. Price 90s.

Thermodynamics. By Gordon J. van Wylen. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 64s.

Symbolic Logic and Intelligent Machines. By E. C. Berkeley. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 52s.

The Protection of Motor Vehicles from Corrosion. Society of Chemical Industry, 14, Belgrave Square, London, S.W.1. Price 22s. 6d.

Strength of Materials for Engineers. By D. R. Axelrad. Sir Isaac Pitman and Sons, Ltd., Parker Street, London, W.C.2. Price 55s.

Mathematics for Telecommunication Engineers. By S. J. Cotton. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 37s. 6d.

Radio Stations—Installations, Design and Practice. By G. A. Chappell. Pergamon Press, Ltd., 4 and 5, Fitzroy Square, London, W.1. Price 50s.

Molecular Science and Molecular Engineering. By A. R. von Hippel. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 148s.

Australian Atomic Energy Symposium, 1958. Australian Atomic Energy Commission, 45, Beach Street, Coogee, N.S.W., Australia. Price 100s.

Electricity Supply in England and Wales

THE first annual reports and accounts (January 1, 1958–March 31, 1959) of the two statutory corporations set up by the Electricity Act of 1957—the Electricity Council and the Central Electricity Generating Board—were published last Tuesday.

It will be recalled that the Electricity Council is the medium for central consultation and formulation of general policy for the electricity supply industry in England and Wales. Both the generation and distribution sides of the industry are represented on the Council. The main functions of the Council are to advise the Minister of Power on questions affecting the supply industry and " to promote and assist the maintenance and development by Electricity Boards in England and Wales of an efficient co-ordinated and economical system of electricity supply."

For its part the Central Electricity Generating Board (C.E.G.B.) owns and operates the public supply power stations and the main transmission lines connecting them in England and Wales. The C.E.G.B. supplies electricity to the twelve Electricity Boards which are responsible for nearly all the distribution and sales of electricity to consumers.

To discharge its responsibilities and use its assets effectively the Board has carried out a reorganisation with the object of striking the correct balance between central responsibility and executive freedom of action. This has involved two major changes. The first has been the grouping of the existing eleven divisions (which continue as operating divisions) into five regions each with a regional director. Clearly defined authority has been given to these regions for the management and operation of the power stations and the Grid to the requirements of national control, and the planning, design and construction of certain capital works. Close liaison is maintained with national headquarters, and between individual regions.

The second major change has been the transfer to three project groups, covering England and Wales, of the design and construction responsibilities of the divisions for new power stations and associated substations These project groups have no defined boundaries and comprise the design and construction engineers formerly employed by the Divisions. The work of building the large new nuclear and conventional stations can thus be spread more evenly than with the original divisional arrangement.

At March 31, 1959, the Generating Board owned 238 power stations in England and Wales with a total installed generating capacity of more than 25,409MW and a total maximum output capacity, with all plant in service, of 23,400MW. Plans have been made by the Board to increase the generating capacity by over 50 per cent during the six calendar years 1959–64. These plans cover a total of thirty-three new power stations, and new sections and extensions to power stations, and represent a net addition of some 10,350MW of output capacity. Altogether some 12,350MW of new plant are expected to be provided but about 2000MW of old plant are expected to be shut down to make way for new plant or because it is unserviceable or uneconomic. New plant brought into service in fifteen power stations during 1958–59 provided an additional output capacity of 1,057,000kW (1,400,000 h.p.).

Because of the change in the national coal situation the National Coal Board substantially increased its estimates of coal available for electricity generation. As a consequence, in addition to the revision of the oil-burning programme detailed in the Annual Report for 1957–58 whereby the number of oil-burning stations was reduced from seventeen to fourteen, it was decided that further amendments would be made : they were that Littlebrook " B " at Dartford should remain a coal-fired station for a further twelve months and the conversion of additional boilers at Brunswick Wharf, Poplar, should be deferred for a similar period. Certain boilers at Portishead " B," near Bristol, will not now be converted to oil. Although the present growth of coal stocks is largely the result of short-term factors, the long-term fuel prospect for electricity supply is better than appeared likely at the time the oil-burning programme was initiated. Thus the planned programmes provide for an increase in annual coal consumption from 42,000,000 tons in 1958 to 50,000,000 tons in 1964. It is, however, too early to forecast the most economical balance of coal, nuclear fuel, and oil, for years after 1964.

Construction has proceeded broadly to programme on the Board's first three nuclear stations at Berkeley (Gloucestershire), Bradwell (Essex), and Hinkley Point (Somerset). Work began on the Trawsfynydd station in North Wales in July, 1959. In addition the consent of the Minister of Power has also been received for the 500MW station to be sited at Dungeness, and application for consent has been made for two other sites—one at Sizewell, Suffolk, and the other at Oldbury-on-Severn, Gloucestershire.

About 91,753,000,000 units of electricity were generated at the power stations in England and Wales in 1958–59, i.e. 5·9 per cent more than in the previous year. Of the total units generated, 99·82 per cent were produced by steam plant using coal, coke breeze or oil as fuel.

Improvement in thermal efficiency of generation has continued. From the 1947–48 figure of 20·91 per cent for the steam power stations as a whole, the thermal efficiency has now reached 26·10 per cent.

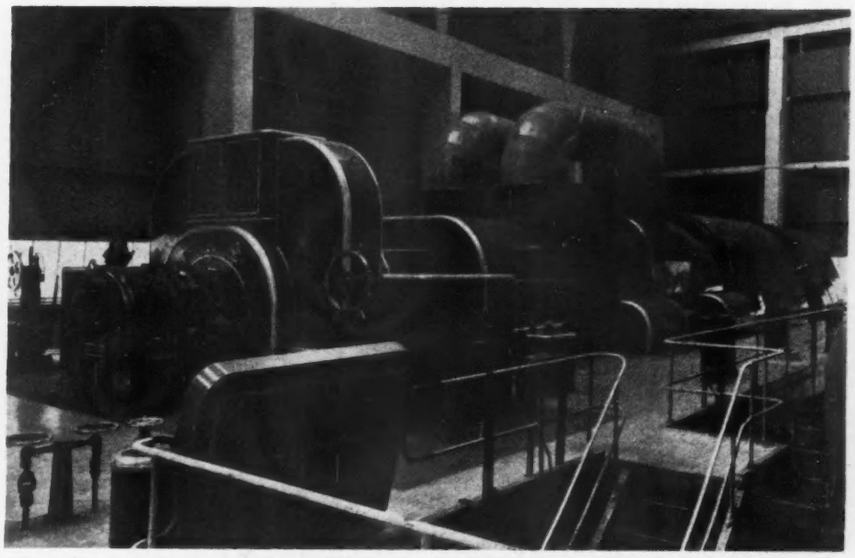
The average delivered cost of coal for the year ended March, 1959, was 79s. 5d. per ton—2·3 per cent below the cost of 81s. 0⅛d. for 1957–58. The calorific value of the coal fell from 10,523 B.Th.U. per pound in 1957–58 to 10,442 in 1958–59. At the end of March, 1959, solid fuel stocks stood at 5·78 million tons, equivalent to nearly six winter weeks' supply.

The maximum demand in the year ended March 31, 1959, occurred on Wednesday, January 14, 1959, and amounted to 20,899MW. This compared with a maximum demand of 19,311MW in 1957–58.

The system load factor, based on the maximum demand, was 47·2 per cent (48 per cent in 1957–58). However, as indicated in C.E.G.B. annual report, actual yearly figures, calculated on maximum demand and units supplied, can be misleading because weather can have such varying effects. Moreover, the shortage of generating plant in the early 1950s, and consumers' load-spreading schemes, kept demand at an artificially low level without a corresponding effect on unit consumption, and thus artificially raised the load factor.

An assessment has therefore been made for England and Wales of : (*a*) the maximum demand that would have been supplied in each winter in " average cold spell " weather, with enough generating plant to meet the demand ; and (*b*) the unit output in each year, assuming normal weather. The adjusted load factors calculated therefrom show a marked improvement over the past ten years. In 1948–49 the adjusted load factor was 43·5 per cent, while the figure for 1958–59 was 46·5 per cent.

At March 31, 1959, the Grid system of main transmission lines comprised 6337 route miles of overhead lines and underground cables, of which 819 miles operated at 275kV, 5157 miles at 132kV, and the remainder at 66kV. There were 412 Grid substations, with a total transformer capacity of over



The No. 2 turbo-alternator at Willington " A " power station has both stator and rotor conductor internally (directly) cooled by hydrogen at 30 lb per square inch

36,000,000kVA. A further 200 route miles of the 275kV Supergrid were completed during the year, and approval was given to the construction of further sections having a total route length of 90 miles. The 275kV crossing of the River Severn by two 512ft towers was nearly completed.

At the lower voltage of 132kV, approval was given to the construction of 111 route miles of overhead line and 15 miles of underground cable. A total of twenty-three new points of supply to the area electricity boards was agreed.

Plant Design and Development

The size and steam conditions of power station plant have been rapidly stepped-up in recent years. The larger, higher-pressure, higher-temperature sets generate more electricity per ton of coal, economise in materials and building space, and, for a given capacity, can be run by fewer operatives.

By the beginning of 1958, when the Generating Board took over, a few conventional sets with an installed capacity of less than 120MW were being included in new plant programmes, and programmed sets ranged up to 200MW, 275MW and 550MW. This last is a two-line turbine which will operate, like the 275MW set, at 2300 lb per square inch and 1050 deg. Fah./1050 deg. Fah. reheat.

The programme for 1964, approved by the Board during 1958–59, includes units of 550MW, 350MW or 375MW, 300MW and 120MW, the balance being provided by nuclear plant. The 550MW units will be installed at Thorpe Marsh, near Doncaster. For the next largest unit it is intended to obtain competitive tenders for two alternatives : (*a*) a unit set of 350MW rating designed for initial steam conditions of 2300 lb per square inch and a temperature of 1050 deg. Fah., with reheat to 1050 deg. Fah., and (*b*) one of 375MW, to operate at a supercritical steam pressure of 3500 lb per square inch* and 1100 deg. Fah./1050 deg. Fah. reheat. The 300MW set, like one in the 1963 programme, will operate at 2300 lb per square inch and 1050 deg. Fah./1050 deg. Fah. reheat. The design problems of the supercritical unit were investigated during the year, and the optimum rating and steam conditions established. Special attention was paid to suitability for two-shift operation, which is a particularly exacting requirement with this kind of set.

The largest sizes of circulating water pump are increasingly difficult to manufacture on conventional lines, and development work was started on a new type consisting of a mixed flow pump having its volute cast in concrete on site.

The two generators with water-cooled stator windings—one of 30MW at Bold " A " (St. Helens), and the other of 60MW at Tilbury " A "—continued to give satisfactory service. The second 60MW prototype, at Bold " B," is due to be brought into operation this year.

The 100MW generator with both stator and rotor conductors internally cooled by hydrogen at 30 lb per square inch gauge was in operation at Willington " A " (near Derby). This machine (illustrated opposite) is the first to have all the conductors so cooled. It is a prototype design for the 200MW generators to be installed at High Marnham (near Retford), the first of which entered the final stage of construction during the year. Three further generators using a hydrogen pressure of 30 lb per square inch gauge, two of them with internally-cooled tubular rotor windings, were also brought into operation. This brought the total capacity of hydrogen-cooled generators to nearly 10,000MVA.

Successful results were obtained with an a.c. generator and germanium rectifiers to supply rotor excitation for a 30MW machine, and investigation into the use of this kind of equipment with the largest machines, to overcome the problem of exciter brush wear, has started. The development of the high-rated silicon rectifier, and the possibility that it will enable rotating rectifier assemblies to be constructed, may lead eventually to the elimination of all heavy current brush gear in the generator excitation circuit.

Further examination of the use of higher magnetic flux densities in large transformers, to reduce cost and to allow larger transformers to be built within road transport limits of weight, has led to the acceptance of flux densities up to 17,000 gauss for cold-reduced grain-oriented steel for the 310MVA generator transformers associated with the 275MW and 550MW generating sets. This permits the transformers to be three-phase units.

For the new large generating units, 11kV is needed to supply the large motor-driven auxiliaries and as a distribution voltage for auxiliary circuits. Suitable air break switchgear is available.

Large slipring motors are being used increasingly for variable-speed feed-pump drives, and manufacture was started of a number of two-pole motors with ratings up to 8000 h.p. The first of the feed pump motors for the High Marnham station, two-pole squirrel-cage machines of 6150 h.p., passed its tests satisfactorily.

A new kind of element in regenerative air heaters for boilers has proved capable of increasing the heat transfer rate by some 20 per cent, permitting construction of air heaters of correspondingly larger capacity. This is expected to make practicable the use of only three heaters for the boiler for a 550MW set and two for the boiler for a 375MW set.

To meet the requirements of the larger boilers, larger coal-pulverising mills are being developed, of a capacity up to 50 tons per hour.

Investigations continued into methods of improving the control of power station plant. A trial installation which will automatically log data on plant operating conditions was ordered for the station under construction at Northfleet. A study was commenced of the practicability and profitability of installing equipment to start up and shut down generating units automatically.

A new kind of packing for cooling towers, using asbestos cement sheets, was investigated and will be incorporated in a tower to be constructed at Staythorpe " B." A new type of spray eliminator made of asbestos cement has also been developed. Tests indicate considerable advantages over existing designs, and full-scale trials will be held at Staythorpe.

Research

The Electricity Council is responsible for settling, in consultation with the Minister, the research programme of the industry and for securing its implementation.

Within this programme, the Generating Board, in view of its size and unique problems, organises and executes its own research, mostly in laboratories and establishments under its direct control. It is considerably extending its activity in this sphere. Distribution and utilisation research calls for different treatment to avoid unnecessary overlapping between the activities of the twelve Area Boards, and the programmes in these fields are co-ordinated through the Council. The whole picture is brought into focus in the Electricity Council which is itself advised by the Electricity Supply Research Council which includes a number of eminent scientists outside the supply industry as well as representatives from the industry itself.

The research expenditure of the industry in 1958–59 was over £1,250,000.

The following are typical lines of research at the Central Electricity Research Laboratories, Leatherhead.

A small-scale prototype computer has been developed to help in the allocation of coal between pits and power stations so that the cost of transport is kept as low as possible. The model has been used in the South Eastern Division with promising results.

An investigation was started into the stresses induced in concrete bulk reactor shielding by the temperature levels and gradients existing across it, in order to examine the possibility of raising the operating temperature conditions within the biological shield and to rationalise the engineering design. Instruments for the measurement of strain and moisture content within the shields at Hinkley Point were installed in No. 1 reactor, and more extensive use of such instruments will be made in No. 2 reactor. In addition, a series of cylindrical models is planned in order to assess the maximum permissible temperature gradients across structures of this shape, and to determine the optimum reinforcement design.

An important limitation in the operation of gas-cooled reactors is the temperature at which the " magnox " fuel element cans may be operated. So that their safe working temperature should not be exceeded at any point in the reactor, it is necessary to have a detailed knowledge of their heat transfer properties ; and in this respect the Board is interested not only in the basic design data, but also in the possible effects of distortion which may occur after long periods of service in the reactor. Two test plants are in use, the first operating at atmospheric pressure, and the second with carbon dioxide at the full reactor condition of temperature and pressure. In these plants, the nuclear heating is simulated electrically, and values of up to 15kW per foot length of can may be applied.

During the year an assessment was made of the progress of the concept of the advanced gas-cooled reactor, with particular reference to the earliest date on which reactors of this type might be introduced to the Board's system. This led to a decision to study the practicability of writing a specification for such a reactor, using a uranium-oxide fuel canned in stainless steel.

The Board's interest in pre-stressed concrete techniques led to a review of the available data on the irradiation behaviour of concrete, and to the conclusion that the data were inadequate for the design of pre-stressed structures. This was discussed with the Atomic Energy Authority, and as a result a new irradiation programme was formulated in association with the Cement and Concrete Association and the Building Research Station of the Department of Scientific and Industrial Research. The programme is being implemented in research reactors at Harwell. Moisture gauges and thermocouples were installed within the biological shields of No. 2 reactor at Bradwell and No. 1 reactor at Hinkley Point, to

* i.e., above the critical value of 3206 lb per square inch absolute.

obtain field measurement when the reactors are commissioned.

Much attention was given to the kinetic behaviour of reactors. In order to provide the necessary computing facilities, arrangements were made to obtain and staff a 200-amplifier Type 23 IR precision analogue computing equipment.

The phenomenon of spatial instability in reactors has required special consideration because of the complexity and size of the computational problem. The primary approach hitherto has been by two-dimensional approximations which are intended to lead ultimately to an understanding of the complete problem. During the year the Board pioneered a three-dimensional approach.

Field Cycle Project.—The Field cycle† is a completely new steam cycle which promises to give a high thermal efficiency. The process consists of two interconnected cycles with steam as the working fluid. The primary cycle is somewhat analogous to that of a closed-cycle regenerative gas turbine, steam being compressed to a comparatively low pressure, superheated to a temperature of the order of 1400 deg. Fah., and then expanded in a turbine which is coupled both to the compressor and the generator. A fraction of the primary cycle steam is passed to a conventional Rankine cycle turbine which is also coupled to the generator. The condensate is evaporated by spraying into the primary cycle steam, which is just de-superheated in the process.

After tests with both wet and dry steam had shown the feasibility of steam compression, a major feature requiring separate testing was the superheating of steam to 1400 deg. Fah. An experimental superheater for investigating this problem has been under construction at Littlebrook power station and is almost completed.

The superheater is to be fired by pulverised fuel, and will first be operated with water-cooled tubes of inexpensive material in order to make measurements of radiant heat flux along the length of the flame. These measurements will be used in the final design, which will use more expensive heat-resisting alloy steels. When a satisfactory design is evolved, it is hoped to construct a self-contained 15,000kW pilot plant to test the complete cycle.

Revenue and Expenditure

The combined revenues of the industry amounted to £517,800,000, and the combined expenditure on revenue account was £490,400,000, of which the largest items

	£	£
Central Electricity Generating Board		10,763,488
Area Boards :		
London	3,629,012	
South Eastern	753,111	
Southern	1,659,760	
South Western	612,386	
Eastern	3,272,613	
East Midlands	1,860,098	
Midlands	118,608	
South Wales	486,917	
Merseyside and North Wales	129,271	
Yorkshire	1,165,929	
North Eastern	871,564	
North Western	2,012,449	
		16,571,718
		27,335,206

were £235,500,000 for generation costs, £80,500,000 for depreciation of fixed assets and £60,100,000 for interest charges.

Revenue from sales of electricity increased from £464,100,000 to £505,800,000. This 9 per cent. increase over the previous year was due partly to the 7·5 per cent increase in the number of units sold and partly to the retail tariff increase made during 1957–58 becoming fully effective throughout 1958–59. The average price of electricity to consumers was 1·554d. compared with 1·533d. per unit in 1957–58.

The industry's consolidated surplus, after payment of interest on stocks, Exchequer advances, and other capital liabilities, was £27,300,000. The surplus makes an essential contribution to the industry's capital financing and to the discharge of its obligations in such fields as the standardisation of systems of supply.

Every Electricity Board earned a surplus on the year's working, the individual results being as tabulated in column one above.

Included in the consolidated surplus was the net surplus of £3,700,000 on "contracting and sales of fittings" account, reflecting not only higher sales of fittings, but also improvements in organisation and administration.

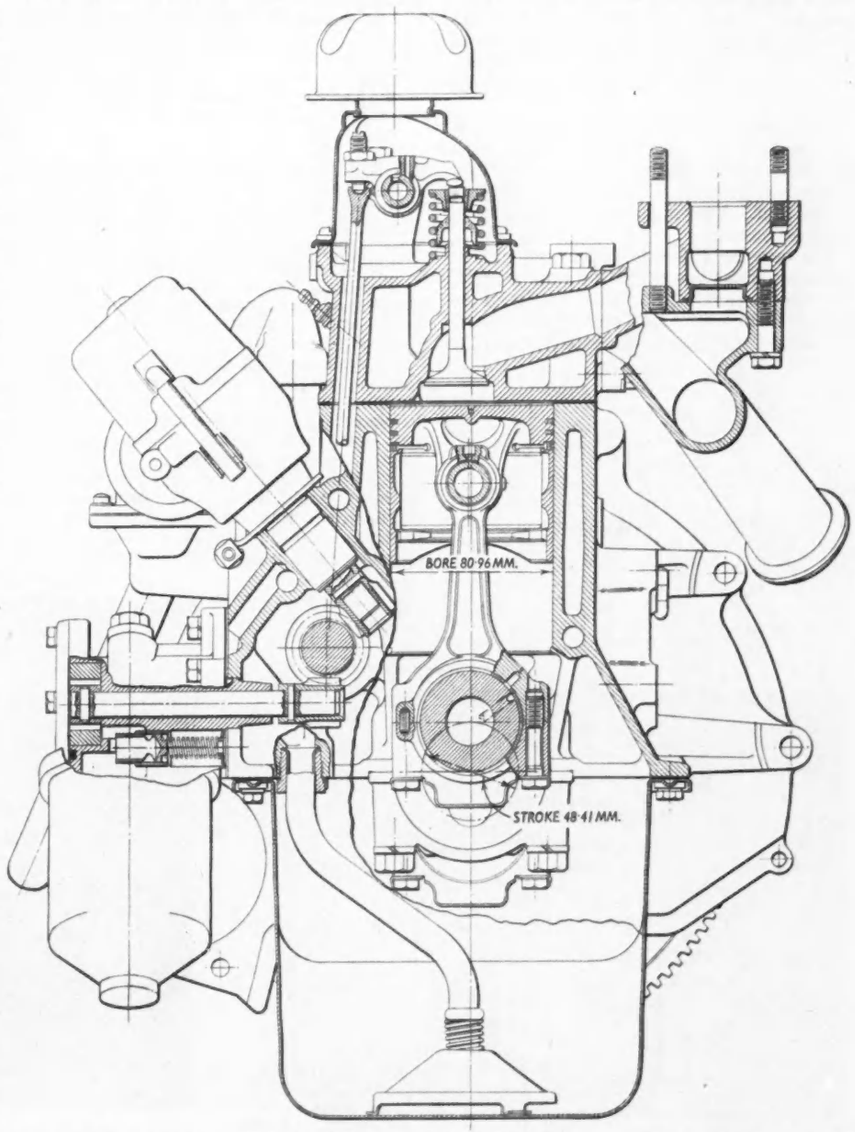
† Proposed by the late Mr. J. F. Field.

Redesigned Light Car

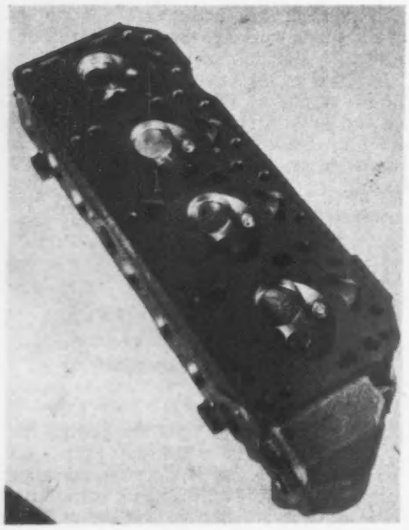
A new design announced this week by the Ford Motor Company, Ltd., differs in all but name from their previous cars. It has a four-speed synchromesh gearbox, such as has previously been confined to the "Thames" range, and a semi-floating rear axle.

A NEW car introduced by Ford Motor Company, Ltd., has been given the designation "Anglia." It is a two-door, four-seater, but differs from previous models of the same name in having a push-rod engine, four-speed gearbox, and semi-floating axle.

The engine of the new car is very much over square, having a bore and stroke of 3·1875in by 1·906in, giving a swept volume of 997 c.c.: the compression ratio is 8·9, requiring the combustion chambers in the cast iron head to be fully machined. The gross output is 41 h.p. at 5000 r.p.m., and the net is little less at 39 h.p.: the maximum torque of 55ft-lb at 2700 r.p.m. corresponds to a brake mean effective pressure of 136 lb per square inch. The new axle has a ratio of 4·125 (the 4·429 ratio is optional on export cars), giving a piston speed of only 1186ft per minute at 60 m.p.h. The short stroke and wide cylinder centres result in a stiff crankshaft with three bearings, the webs



Cross section of engine. Notice the bell-mouthed inlet ports, shrouded valves in integral guides and screws retaining the big-end cap



The combustion chamber is machined all over to control the high compression ratio of 8·9. Notice the separate ports, machined in the case of the inlets

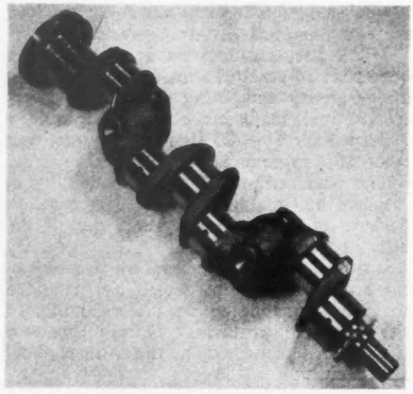
between cranks 1 and 2 and between 3 and 4 being cast hollow. The oil pump is mounted outside the engine and sucks through a long pipe: the spill from the relief valve is piped back down to the sump. The mechanical fuel pump has no provision for hand priming.

Transmission is by a four-speed gearbox with blocker type synchromesh and an open shaft to a hypoid rear axle. Hotchkiss drive is used at the rear, MacPherson suspension at the front. A recirculatory ball worm steering gear is used.

The new car differs from previous models in its electrical system. This now supplies the windscreen wipers, and the need to protect them from snow and freezing water has caused the fuses to be brought into the cabin in front of the driver. The dip switch is now hand operated, but retains the push-push-push functioning, so that a warning light is necessary. The twin indicator switch also operates the horn.

Wheelbase	90·5in
Track :	
Front	46in
Rear	45·8in
Length	12ft 10in
Width	4ft 9in
Turning circle	32ft
Weight, kerb	1625 lb
Tyres	5·20+13, 4-ply
Gear ratios :	
First	4·11
Second	2·39
Third	1·41
Fourth	1·00
Final drive	4·125

The body of the new car is distinctively shaped. Whereas the original "Anglia" had front and rear windows plane and the 100E model had both curved, the latest design has a curved windshield and a plane rear light : the drag coefficient is claimed to have been found acceptable in wind tunnel tests, but has not been disclosed. The interior dimensions are claimed to be particularly large for a car of this size, and, in fact, the headroom in the rear seat is nearly 2in more than in the original "Anglia"; although the cushion height has been reduced by more than 1in, the effective leg room is only ½in less in the new car. The width inside is the same, but the hip room on the rear seat is about 6in greater. Each front seat is nearly 2in wider, and the pendant pedals have allowed an increase in the driver's leg room. A feature familiar on Taunus cars is that the rear windows open by rotation about their leading edges. As on the preceding model, both bonnet and boot open forward ; the spare wheel fits vertically at the front of the boot. The filler cap, also vertical, is in the rear wall of the boot.



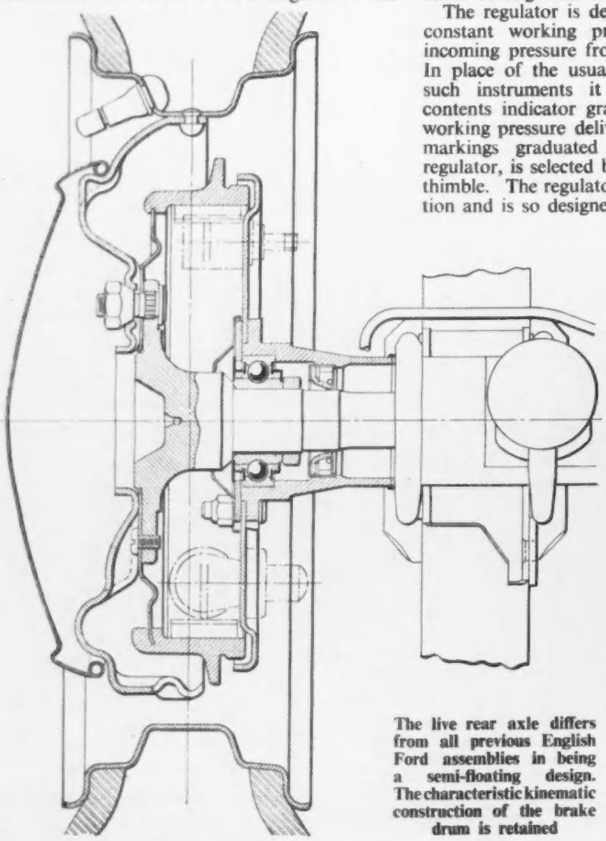
The crankshaft is cast hollow : observe the extreme overlap of the main and crankpin journals, one core extending through two adjacent pins

Oxy-Fuel-Gas Cutting Equipment

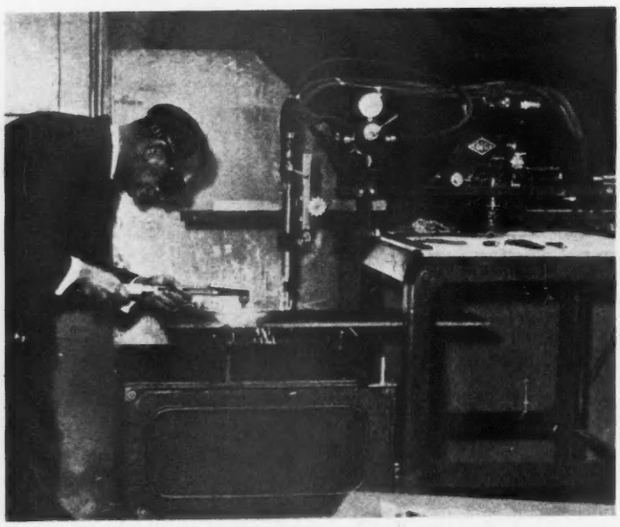
THREE recently developed equipments made by the Harris Caloritic Company of America for use in oxy-fuel-gas cutting are now being manufactured by arrangement in this country by British Industrial Gases, Ltd., 700, Great Cambridge Road, Enfield, Middlesex. These developments include a gaugeless multi-stage regulator, a hand cutting torch and what is known as the "Cutomation" system for use on flame cutting machines.

The regulator is designed to deliver gas at a constant working pressure regardless of the incoming pressure from a gas storage cylinder. In place of the usual pressure gauge fitted to such instruments it has a pop-up cylinder contents indicator graduated in "steps." The working pressure delivered, which is shown by markings graduated on the bonnet of the regulator, is selected by the setting of a screwed thimble. The regulator is of two-stage construction and is so designed that in the event of full cylinder pressure (2000 lb per square inch) being turned on with the adjusting screw set in an intermediate position no damage is caused. This has been made possible by automatically reducing the full pressure by 90 per cent when it enters the intermediate pressure stage chamber. The gas at about 200 lb per square inch passes on into the low-pressure chamber from which the operator controls the ultimate delivery pressure to the service line.

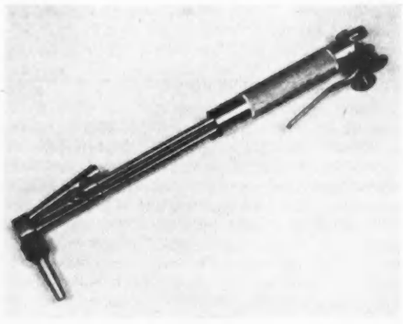
A self-sealing spring-loaded poppet valve protects the intermediate pressure chamber and a working pressure safety valve is fitted to the low-pressure stage. In addition to these safety measures the instrument chambers have supplementary venting means to provide additional protection in the event of excess pressure. All gas from the cylinder is filtered through a sintered metal element before entering the regulator and this filter provides an effective protection against any possible flashback to the cylinder.



The live rear axle differs from all previous English Ford assemblies in being a semi-floating design. The characteristic kinematic construction of the brake drum is retained



"Cutomation" equipment on a flame cutting machine, and cutting torch fitted with a gouging nozzle and using low-pressure propane as a fuel gas, being demonstrated in operation



Hand cutting torch adaptable for use with acetylene, low-pressure propane, coal gas, &c., as a fuel gas

The new hand cutting torch, by the simple process of changing of a nozzle and an injector unit, can be adapted for use in three forms. In one form the torch uses low, medium or high-pressure acetylene as a fuel gas ; in another it uses low-pressure propane, butane or pyrogas ; whilst in the third form it uses coal gas. In view of the relatively cheap and plentiful supplies of propane now available the torch arranged for this fuel gas is of particular interest as tests have shown that, with the proper selection of nozzles and pressures, it uses no more oxygen than is required with acetylene. The torches are primarily intended for use with the Harris regulators, the regulator on the propane cylinder being set at 6 oz. By the fitting of a special nozzle attachment these torches can be used for gouging operations as illustrated.

As can be seen in the accompanying illustration the gas and air control valves are situated in the handle and they are not used for trimming purposes when the Harris regulator controls the supply. These valves are simply turned full on and the gas supply to the nozzle maintained by depression of a lever during the cutting operation. A triangulated arrangement of stainless steel tubes connect the head of the torch and its handle and actual mixing of the fuel gases is effected in this head. An injector in the head serves to stabilise the cutting flame and ensure the correct mixture of gas and oxygen.

The " Cutomation " system developed for use on flame-cutting machines is based upon a new design of nozzle with a convergent-divergent orifice and with it propane is used as a fuel gas. It is stated to make possible an increase of 30 per cent or more in cutting speed ; reduce the required volume of pre-heating gas by some 70–80 per cent ; and reduce overall oxygen consumption by 20 per cent.

The makers state that with the new design of nozzle the cutting oxygen stream expands within the nozzle and not as the oxygen clears the end as hitherto. The shape of the orifice is such that the oxygen flows at a supersonic speed and oxidises the metal to form a narrow kerf at a high speed of cut. Once cutting has commenced the high temperature flame required to start a cut is no longer needed and the volume of oxygen can be reduced by some 75 per cent.

For the system a three-hose injector torch is used as shown on the demonstration rig illustrated. One hose supplies the fuel gas, the second the centre cutting orifice of the nozzle and the third the pre-heating oxygen.

The size of the pre-heat flame is controlled by varying the oxygen pressure and, as the torch is of injector design, the fuel gas supply automatically varies according to the pre-heat oxygen pressure. To control this pre-heat flame an additional regulator of special design is interposed in the oxygen supply line to the torch. This regulator is of dual flow construction with one flow of gas controlled by a manually operated adjusting lever and the other flow by-passing straight through. The regulator can thus be set for the by-pass to give a fast pre-heating flame with oxygen at, say, 40 lb per square inch, and the controlled section to deliver at 10 lb per square inch. Once the cut has started a lever on the regulator is moved over and the reduced pressure of pre-heating gas introduced to the torch.

Heating of New Diesel Trains

THE four-car diesel suburban sets now going into service on the St. Pancras-Bedford service of the London Midland Region, British Railways, were described in our June 12 issue. An inaugural journey was made from St. Pancras to Bedford and back on September 28 by a train of the new stock carrying guests of the London Midland Region, and on the same date other units replaced steam trains on certain off-peak suburban workings as a preliminary to the complete conversion of the St. Pancras-Bedford service to diesel traction as from January 4 next year. Suburban trains to and from Moorgate will continue to be formed of steam stock, the 63ft overall length of the railcars being greater than is permissible over certain curvature on this section, but they will be hauled by diesel-electric locomotives. A new depot for the trains is being built at Cricklewood, but at present they are being stabled in sidings near the steam motive power depot, where diesel fuelling facilities for locomotives already exist.

In our issue referred to above, brief mention was made of the Smiths combustion heaters with which the new rolling stock is equipped. We have now received from S. Smith and Sons (England), Ltd., Industrial Products Department, Witney, Oxon, some details of this installation and the method by which it is controlled, both for heating and ventilation. Each coach is fitted with two Smiths " 40ASM, mark 2B " fully-automatic air heaters, providing a total heat input of 80,000 B.Th.U. per hour. One heater is supported from the underframe at each side of the vehicle. As seen in the accompanying illustration, an air intake filter is fitted at one end, and at the other end an outlet is fitted, leading to a duct system which runs the full length of the coach, admitting air to the passenger saloons below the seats. In the driver's compartment a booster blower is provided for window demisting and defrosting. Each heater consists essentially of a combustion chamber and a heat exchanger, both surrounded by a passage through which air to be heated flows under the action of an axial flow fan. An annular passage around the outside of the air passage receives the hot gases through four radial ports communicating with the combustion chamber and is the means by which they pass to the discharge outlet.

An electric motor in the combustion chamber drives the axial flow fan at one end of its shaft, and is coupled at the other end through a flexible coupling to a displacement piston fuel pump, the spindle of which also carries the combustion air centrifugal impeller, fuel slinger and radiation shield. Ignition of the fuel/air mixture is by a glow plug which is operated only to initiate combustion. Flame detection and overheat thermostats are placed within the air flow.

The heaters are arranged for operation by Smiths automatic " Through Train Control " system, enabling all to be started from one master panel in the guard's van, after which they follow their individual on/off cycling in accordance with the demands of the individual coach saloon thermostats. In mild weather the system may be used to circulate air at ambient temperature by operating the heater axial flow fans only. The control equipment comprises control boxes, local control panels, and carriage thermostats in individual coaches, and a guard's control panel in each train set. A signal light is provided on the guard's panel which gives warning if one or more heaters have failed to start. When this occurs, a similar warning light on the heater local control panel in the coach concerned also illuminates so that the faulty unit may be identified.

If heaters are operated from their local control panels for test or other purposes, rectifiers in the control circuits block the transmission of the operating signals to other units. Further rectifiers are used in the system to prevent feedback effects which could, under certain conditions, energise relays out of true sequence.

Starting is controlled by a timer motor driving four cams through a gearbox. The cams operate microswitch contacts so that the following sequence of operations takes place at each heater :

(1) Motor starts and fuel valve solenoid is energised, admitting fuel for " wetting cycle."

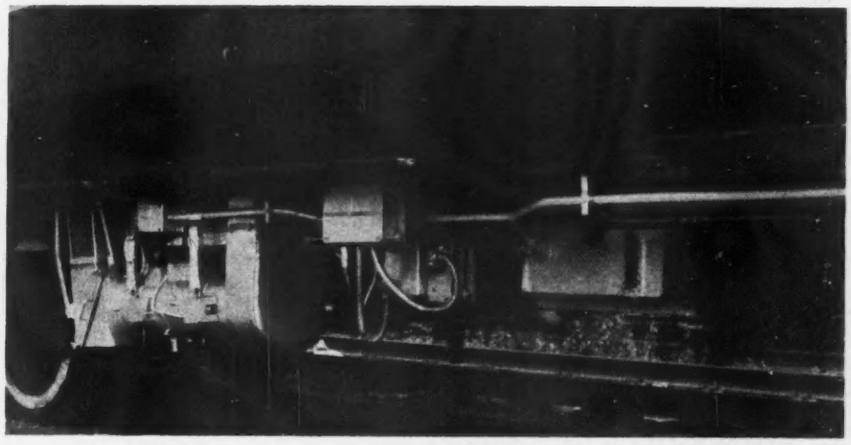
(2) Motor stops and glow plug is energised for thirty to forty-five seconds.

(3) Motor restarted, so that fuel is drawn into the combustion chamber and combustion begins.

(4) Detection of heat by thermostat initiates various circuit changes, leading to de-energisation of glow plug and continued rotation of timer motor to return cams to their starting position.

Continued functioning of each heater is then dependent on the coach air temperature, heat detection and overheat thermostats. Heaters are switched off collectively by opening the guard's panel isolator switch, which de-energises all control circuits and extinguishes all indicator lamps, but should a heater be performing a heat cycle at this time, a circuit is still maintained for its air fan motor by the " hot " contact of the heat detection thermostat and so the heater completes a normal shut-down cycle.

In connection with this installation of " Through Train Control," a special-purpose electrical plug and cable assembly has been developed by Modern Acoustics, Ltd., Manor Way, Boreham Wood, Herts (one of the Plessey Group of Companies). The assembly has been given additional robustness and weather-proofing by moulding the cable to the connector, which is a multi-contact design in which each plug contact blade is gripped by a series of spring banks, to ensure a clean and positive contact at all times.



Oil combustion heater installation on trailer coach of four-car diesel set, London Midland Region. The air intake filter and connection to the coach ducting are seen at opposite ends of the cylindrical heater unit

SHORTER REPORTS

British Waterworks Association

THE following statement has been issued by the British Waterworks Association :

Taking the period from May to the end of August, 1959, there has not been a drier summer this century. September has continued dry and there is every sign of this summer being the driest ever recorded. Water authorities have had to supply more water than ever before at a time when their sources of supply have suffered from one of the lowest rainfalls on record. The fact that the great majority of the people of the country have been able to rely upon a normal water supply in these conditions is remarkable. The water authorities have been in a better position to meet a drought of this intensity than at any previous time in history. This is because of the capital works carried out since the war. Up to the moment relatively few water undertakings have had to impose restrictions on their supplies beyond the banning of the use of hose pipes. Real difficulties have occurred only in few areas and have affected a small percentage of the population. Many water authorities relying on impounding reservoirs are now becoming seriously concerned about the fall in the level of their reservoirs and the absence of rainfall in sufficient quantity to replenish them. They are issuing appeals to their consumers for economy. A number now has less than fifty days' supply in hand and if the dry weather continues during October they will have to impose severe restrictions on the supply in order to conserve what remains in the reservoirs. Arrangements have been or are being made for water authorities with good stocks of water to help out their less fortunate neighbours by bulk supplies.

Centenary of Far-Eastern Voyage of a Ben Line Ship

To mark the centenary of the first voyage to the Far East undertaken by a ship of the Ben Line, a small exhibition was mounted in the wheel-house of the company's cargo liner "Benvrackie." The display represented a cross section of the history of the company which had its beginnings in 1825, when the brothers Alexander and William Thomson began to import Carrara marble, for their business, from Leghorn, Italy. However, the first recorded Thomson ship was the barque "Carrara," of 218 registered tons, built in 1839, and from that time the line, despite many vicissitudes, has expanded both in number and size of ships and in its activities. One of the earlier ships was represented by a model of iron hulled barque, "Bencleuch II," measuring 247ft long by 37ft beam by 22ft depth, of 1418 gross register tons, and built in 1875 by R. Steele and Co., Greenock. An example of the clipper bow steamers was a model of "Benlomond II," built by Bartram and Sons, Ltd., Sunderland, in 1911, and having a length of 405ft by 51ft beam by 27ft deep, while a third model was that of the latest member of the fleet, the "Benloyal II," built by Charles Connell and Co., Ltd., in 1959, and driven at a service speed of 19 knots by geared turbines built by David Rowan and Co., Ltd. This ship was described in our issue dated March 13. Other ships, illustrating the changing concept of design and development, were represented by photographs and included two ships built by Alexander Stephen and Sons, Ltd., the "Benvenue I," in 1883, and the "Benlomond," in 1890 ; the "May Queen," built in Quebec, and the "Araby Maid." It was a barque rigged ship of the latter name which sailed on September 24, 1859, for the Far East and so opened up the trading activities which remain the active concern of the Ben Line to-day. Also on view were an old voyage account book, a volume setting out detail costs of a ship built in 1871, and various other historical documents. Of particular interest were several bottles which had contained sherry which had, following an old custom, made the journey to the Far East for the benefit of the voyage.

Opening of the Whitegate Refinery

A PROJECT, long conceived, to set up a refinery in Ireland, has been successfully completed with the construction of a refinery at Whitegate, Cork, and its official opening by Mr. Sean F. Lemass, the Prime Minister of the Republic of Ireland, on Tuesday, September 22. The plant, which has a designed capacity of 2,000,000 tons per annum, is operated by the Irish Refining Company, Ltd., which was established as a consortium of the California Texas Oil Corporation, the Esso Petroleum Company, Ltd., and Shell-Mex and B.P., Ltd. In opening the proceedings Mr. Dewdney, the chairman, thanked the various authorities concerned for their co-operation and commented that an investment of £12,000,000 had called for careful consideration and an assessment of many factors. It was an exceptional situation, he continued, for three oil companies to promote such a joint enterprise, but pointed out that co-operation only covered the refining stage and that the marketing of the products would remain competitive. Mr. Lynch, Minister of Industry and Commerce, noted that only 200 acres of the total of 1300 acres had been developed so that there was adequate room for expansion to meet any increased demand for petroleum products. He went on to mention various schemes related to industrial expansion around the port and harbour of Cork, including the construction of an airport. The Prime Minister remarked that the completion of the refinery indicated that Irish industrial development was now in its second phase; he thought that development sponsored by competent private enterprise was very sound. The coming on stream of the refinery represented an important factor in the economy of the country and, he said, opened up further possibilities of industrial expansion. Mr. Lemass declared the refinery officially in operation by opening a triptych, in silver, consisting of a centre panel, giving a general view of the refinery, flanked by two panels, one of which represented an ancient Irish tower and the other a typical refinery tower.

Microwave Telephone Network in Malaya*

THE first microwave main-line trunk telephone network in Malaya was officially inaugurated on September 26 between Kuala Lumpur and Singapore. In recent years the major part of the trunk telephone traffic in southern Malaya has been carried by v.h.f. radio links which provided ninety-six circuits between Kuala Lumpur, Malacca and Singapore. When increasing demands on the service made it necessary to provide additional circuits, the Pan-Malayan Department of Telecommunications anticipated future expansion by installing the new microwave system. Initially this system is equipped to provide less than its full capacity of telephone circuits and additions can be made when required.

In 1957 Standard Telephones and Cables, Ltd., was awarded a contract by the Crown Agents for Oversea Governments and Administrations to supply and install 4000 Mc/s and 7400 Mc/s microwave systems to connect Kuala Lumpur and Seremban with Malacca, Tampin, Kluang, Johore Bahru and Singapore. The consulting engineers to the Crown Agents for the whole project were Messrs. Preece, Cardew and Rider. Equipment on the main route works in the 4000 Mc/s band with a capacity of 600 telephone circuits, while the spurs to Johore Bahru and Seremban will employ 7400 Mc/s equipment with a capacity of 240 telephone circuits. Sites for the terminal stations have been chosen so that only short lengths of cable are required to connect the radio equipment with the multiplex channelling equipment and the exchanges. The only exception is Kluang, where 5 miles of carrier cable is used to connect the exchange with the radio equipment on Gunong Lambak. At most repeater stations the administration has erected reinforced concrete buildings with roof-mounted steel structures to support the microwave aerials. Normally the ground floor houses engine generator sets, the first floor the fuel tanks and the top floor the radio equipment. Buildings of this type have been built on Gunong Pulai, Gunong Lambak, Bukit Jinsir and at Tampin and S'Pang. At Fort Canning and Jementah new self-supporting steel towers of 170ft and 150ft respectively were erected, while on Bukit Nanas, and at Malacca and Gun Hill the aerials are mounted on existing radio masts.

The network comprises six radio links interconnected by multiplex channelling equipment to provide direct circuits between the various exchanges in the network. The main route from Kuala Lumpur to Singapore and the spur from Tampin to Malacca consist of duplicated S. T. and C. "RL4C" radio equipments of 600 circuit capacity. This system operates in the 3800–4200 Mc/s band, using the C.C.I.R. frequency allocation plan. It provides an output of 5W from a travelling wave amplifier which feeds a 10ft diameter parabolic antenna via waveguide feeders. On the spur routes from Tampin to Seremban, and from Kluang to Johore Bahru, "RL7A" equipment having a capacity of 240 telephone circuits will be used, also in duplicate. This works in the 7300–7500 Mc/s band with a transmitter power of ½W into 8ft parabolic antennae. Supervisory systems on both routes allow the control stations at Kuala Lumpur, Fort Canning and Malacca to initiate certain remote control switching operations at the other stations, which are designed for unattended operation. The supervisory and control facility of the "RL4C" equipment employs an independent s.h.f. channel interconnecting all stations on the route.

Both systems are equipped with multiplex channelling equipment providing up to 600 C.C.I.T.T. carrier telephone circuits spaced 4 kc/s apart in the band 60 kc/s to 2·6 Mc/s. Crystal filters enable a single stage of modulation to be employed in the formation of the basic twelve-channel group in the frequency band of 60–108 kc/s.

Communications Equipment Display†

NEW items of telephone and radio equipment featured in a display held at the Royal Station Hotel, Newcastle, on September 29 and 30 by the mobile display team of Siemens Edison Swan, Ltd. A private telephone exchange switchboard was exhibited in which no cords are used, connections being set up by means of lever-operated keys and numbers dialled by push-buttons. Operating the board involves fewer movements and reduces fatigue. Similar operating principles were used in the automatic trunk switchboard supplied by the company for the Post Office at Middlesbrough, but the P.A.B.X. version incorporates a new type of two-motion automatic switch for switching incoming and outgoing calls.

A new telephone instrument with built-in loudspeaker was shown, which is available for direct connection to other similar instruments without going through an exchange. A press-button in the handset or on the base of the instrument enables a caller to operate the remote loudspeakers (which are switched out when a handset is lifted) for paging purposes, and during normal conversation an indicator light on all instruments shows that the circuit is in

* Enter No. E3624 on Reply Card.

† Enter No. E3625 on Reply Card.

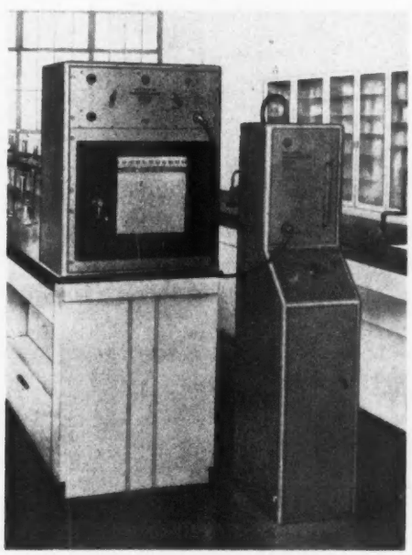
use. The telephone display also included a new version of the "Silent Call" instrument in which the whole handset lights up to show an incoming call, replacing the previous lamp signalling unit.

Radio and ship communication exhibits were arranged by the Marine Department of Siemens Edison Swan, Ltd. Among them were two new 600W ship's transmitters, one of which was shown in conjunction with speech inversion equipment for privacy of telephone conversations when they are being conducted with a shore subscriber through a shore station radio/landline link. A low-power radio telephone equipment for small coastal vessels was shown incorporating a generator for sending the two-tone alarm signal which actuates alarm receivers in other ships and at coast stations.

Argon Chromatograph*

THE argon chromatograph developed and made by W. G. Pye and Co., Ltd., Cambridge, makes use of the argon detector originated by Dr. J. E. Lovelock. This detector constitutes a major refinement in the technique of gas liquid chromatography and it is claimed that a sensitivity 10^5 times better than formerly can be obtained with its use.

It may be recalled that in gas liquid chromatography quantitative analysis of organic mixtures is effected by injecting the sample (liquid or gaseous) into a stream of carrier gas at one end of a separating column. As the mixture passes along the column the individual components are retarded to various extents by the packing material in the column. On emerging from the other end of the column the carrier



Argon chromatograph for the quantitative analysis of liquid or gaseous organic mixtures

gas elutes each of the components in turn at different time intervals. A suitable device is used to detect the components and a recorder is usually incorporated to provide a chromatogram—a record consisting of a number of peaks each of which represents the emergence of one of the components from the column. The area of the peak gives a measure of the quantity of the component in the mixture and the time of its emergence establishes the identity of the component.

In recent years thermal methods of detection have been used. However, much higher sensitivities are inherent in the system conceived by Dr. J. E. Lovelock, using an ionisation detector with argon as the carrier gas. The idea is that the argon is excited into its metastable state on entering the detector. As the excitation energy of argon (11·6 electron volts) is higher than the ionisation potential of organic vapours, it follows that any such vapours in the carrier gas stream are ionised on collision with excited argon atoms as they enter the detector. This ionisation causes a considerable increase in the current through the cell. In addition the electrons resulting from this ionisation produce more metastable argon atoms. This effect depends on cell voltage which therefore affords a ready means of achieving greater sensitivity.

The effects of variations in temperature, pressure and flow on the argon detector are so insignificant that the extent of the control is imposed solely by the column requirements.

A typical Pye installation based on these principles is illustrated here: the cabinet on the right is the analysing unit and mounted on a bench on the left is the amplifier-recorder. The detector is mounted at the bottom of the column housing and is connected to the amplifier-recorder by a plug-in cable. The detector consists of a metal block containing a weak source of radioactivity. A special electrode detects the increase of ionisation current that occurs when a component enters the chamber. On the top face of the detector there is a conical seat for the column outlet.

The sample for analysis (usually about 25–100 micrograms) is injected into the system at the top of the equipment. By using special micro-pipettes this operation can be done by relatively unskilled people.

Normally the column is 4ft long, and it can be made of glass, copper or stainless steel, as required. Various packings are available. A column is fitted into the housing, the lower end being pushed into the detector to make a self-sealing joint and column changing can be carried out quickly. An electrically-heated jacket surrounds the column to maintain a uniform temperature along its length, under the control of a thermostat. The operating temperature can be selected on a rotary switch on the control panel. Temperature stability is stated to be within ½ deg. Cent., with a warm-up rate of about 10 deg. Cent. per minute.

Flow can be measured by noting the time taken for a bubble to travel between the marks of a calibrated soap-bubble manometer mounted on the right of the upper (vertical) panel.

Argon is supplied as a carrier gas to the system from an ordinary gas cylinder with a pressure regulator.

The bench-mounted amplifier and recorder gives a high-voltage supply to the detector cell, amplifies the change of current caused by components of the sample passing through the cell, and produces a chart recording. Sensitivity ranges (×1, ×3, ×10) can be selected by switching. A switch at the back of the equipment selects output suitable for a potentiometric or a current-operated recorder. The standard equipment includes a 10mV potentiometric recorder with a 10in chart width and is suitable for a 200/250V, 50 c/s mains supply.

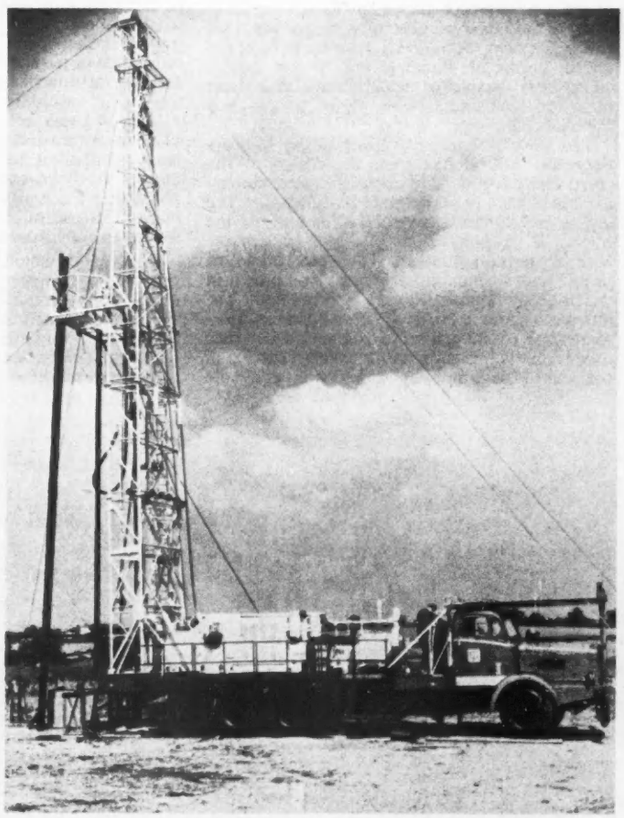
The sensitivity range is stated to be about one part of the component in 2×10^6 to 2×10^3 parts of argon (carrier), for full-scale deflection on the recorder. The limit of detection is given as one part of the component in 2×10^8 of carrier.

* Enter No. E3631 on Reply Card.

Mobile Drilling Rig†

RECENTLY we paid a visit to Egmanton to inspect and witness a demonstration of a new mobile drilling rig which has been designed and built for service in the tropics, particularly desert conditions. This unit, which has been developed by the Piling and Construction Company, Ltd., in co-operation with the B.P. Exploration Company, has a drilling capacity of up to 2500ft with 2⅞in pipe or 2000ft with 3½in pipe, and is mounted on a Thornycroft "Big Ben" 6 × 6, 21ft wheelbase chassis. This is of fabricated steel and fitted with removable side platforms and mounting steps together with four screw-down jacks which fold clear when moving from site to site. Our illustration shows the rig with the mast raised.

Operational power is provided by two Dorman 6 LB engines, each developing 96 b.h.p. at 1600 r.p.m., which drive through fluid couplings and have air starters. A main gearbox compounds both engines via chain drives and helical gearing, and the Thornycroft four-speed gearbox, integrally mounted on the main box, drives the draw-works and rotary table. There is a two-speed drive to the "Ideal" D 50, 5in



Drilling rig with mast raised

by 10in duplex mud pump which discharges at 400 lb per square inch and has a capacity of 202 Imperial gallons per minute in high-speed gear and 162 gallons per minute in low-speed gear. Other drives are to the hydraulic oil pump, lubricating oil pump and the two Broom and Wade 4in by 1⅞in, 700 r.p.m., two-stroke compressors.

The draw-works consist of a double drum equipped with "Air Flex" clutches and a Foster air breakout cathead and a plain cathead. The main drum has eight speeds forward and two in reverse, the hook speed ranging from 34ft to 250ft per minute and the maximum hook load being 35,000 lb. There are two brake drums having a line capacity of 1000ft of ¾in diameter wire line. The sand reel, having a

† Enter No. E3632 on Reply Card.

maximum load of 4246 lb, has four speeds forward and one reverse giving a speed range from 109ft to 524ft per minute and there are two brake drums with a line capacity of 3500ft of $\frac{7}{8}$in diameter wire line.

A "Pilcon" R.T.18 rotary table having spiral bevel gears is fitted and has a split master bushing to receive an A.P.I. Kelly bushing, the full opening being 18in in diameter. Forward speeds of the table are from 39 r.p.m. to 190 r.p.m. while the speed in reverse is 24 r.p.m. The 2$\frac{1}{4}$in bore Kelly of fully heat-treated forged alloy steel, is 28ft long and complete with split A.P.I. bushing. Hydraulic rams raise or lower the electrically welded tubular steel mast which gives a 58ft clearance above the rotary table, and has a capacity of 60,000 lb. It is fitted with a removable crown, racking platform, stabbing platform, crow's nest, ladder and catline sheave, and the two-sheave travelling block has a spring-loaded duplex hook and a capacity of 55,000 lb. The rotary swivel, which has a taper roller thrust bearing, slip-in washpipe and packing and a 2$\frac{1}{2}$in diameter water course, has a capacity of 50,000 lb.

Industrial Tractor and Equipment*

THE 37 b.h.p. tractor equipped with a mounted digger and a power shovel, as illustrated herewith, is the latest product of Massey-Ferguson, Ltd., Coventry. It has been designed to meet the varied needs of building and public works contractors, municipal undertakings and those who are concerned with earth-moving and materials handling.

The tractor, which is known as the Massey-Ferguson 702, is based on the design of the company's "FE35" agricultural tractor, though its appearance is a good deal different. The styling is "industrial yellow." The front of the tractor is designed as a "bumper grille," the bumper portion being a U-shaped frame of heavy plate surmounted by a cast iron crown in which headlight apertures are incorporated. The one-piece front axle is a non-adjustable heat-treated steel casting, fixed to a case-hardened steel tube which is free to pivot in bushings carried in the front axle support. A heavy duty ductile iron front axle support is bolted both to the cylinder block and to the cast iron oil sump, to provide a strong front end structure for the tractor. A separate pump for the front-mounted shovel and rear digger is located on this front axle support and is driven direct from the engine crankshaft.

The tractor is powered by a 37 b.h.p. diesel engine, as used for the Massey-Ferguson "35" agricultural tractor, though the single-plate clutch has a 9in driven plate which is fitted with twelve buttons of "Cerametalic" sintered metal friction material, riveted back-to-back in six pairs. The pressure for the drive is maintained by twelve insulated compression springs. A throttle which can be either hand or foot operated is fitted as standard equipment. Another item of standard equipment is power steering, the steering gear incorporating an external valve for the control of the power steering cylinders. The hydraulic pump which supplies oil for the power steering unit is mounted on an adjustable bracket which pivots on the right-hand side of the front axle support; it is driven by a vee belt from a pulley mounted on the front end of a modified crankshaft pulley. The pump is driven at approximately one-and-three-quarter times the engine speed and, at an engine speed of 2000 r.p.m., provides about 4 gallons of oil a minute.

The new tractor is available either with the conventional brake layout or with a dual braking system. To assist maximum traction under adverse conditions on industrial sites, the rear wheels are fitted with six ply 13×24in tyres, the front wheels being fitted with 7·50×16in eight-ply tyres.

The front-mounted shovel and the rear-mounted digger, both of which are being manufactured at the Massey-Ferguson factory in Manchester, are carried on a common sub-frame. The shovel, which is of box-frame construction, is capable of lifting 2000 lb, at 2000 r.p.m. engine speed, with breakaway at 3000 lb. An overall lift height of 11ft 8in is possible with a bucket clearance height of 9ft 8in and a dump height of 8ft 6in. Two self-centring levers, placed at the operator's left hand, control the movement of the shovel arms and bucket. There are several attachments available for use with the shovel, including buckets with capacities of 11 and 13 cubic feet, an angledozer with a 72in blade, a crane attachment and a fork lift. There is also available a scarifier attachment for loosening up tough ground prior to digging. It has six steel teeth and is fitted behind the loader bucket; the scarifier is used in reverse and floats free when the loader moves forward.

The rear-mounted digger is operated by a gear pump at a pressure of 1850 lb per square inch. The hydraulic systems of the digger and shovel are isolated from each other by a simple change-over valve and the digger is controlled by a bank of six levers placed conveniently for the operator, whose seat swivels with the boom of the digger. The digger boom is raised or lowered by pulling or pushing the first lever, and a second lever operates the rotary actuator. The digger arm is controlled by the third lever, which is pulled to bring the arm towards the operator or pushed to extend it, and bucket crowd is controlled by the fourth lever in the same way. The other two levers control independent vertical stabiliser feet which are contained in the digger frame and which take the strain off the back end of the tractor when the digger is at work.

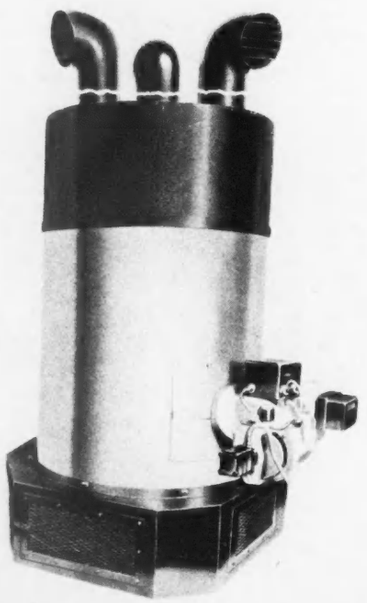
When centrally mounted, the digger has a 185 deg. operating arc and is capable of digging at right angles to the tractor centre line, enabling it to work in confined spaces. It has a reach of 13ft 8in and can dig down to a depth of 12ft. With a trench bucket fitted, there is a dump clearance height of 8ft, which increases to 10ft 2in with a face shovel. The digger, it may be added, can be fitted to either side of the rear frame as an alternative to the centre, the change-over enabling trenches to be dug close to walls and fences. The digger can be readily detached from the tractor; it forms its own tripod when dismounted and no special hoists or tools are needed. The digger is equipped with double-acting hydraulic rams, the pump being capable of sustaining an output of 15$\frac{1}{2}$ gallons a minute at 2000 engine revolutions per minute at 1500 lb per square inch. Ordinary trench and clay bucket attachments are available in 12in, 16in, 20in and 24in widths. There is also a 36in wide utility bucket for such jobs as grave digging, ditch clearance and light soil excavation.

Massey-Ferguson "702" tractor with digger and shovel. Hydraulically operated pads take the strain off the rear end of the tractor when digger is at the work

* Enter No. E3641 on Reply Card.

Space Heaters†

A RANGE of space heating units for industrial establishments, warehouses, offices, &c., is now produced by Speedyheat, Ltd., 44, Tower Hill, London, E.C.3. These "Speedyheaters," as they are known, are oil-fired and self-contained with electrical controls, so that on installation they require, apart from the provision of a flue pipe, merely connecting to the power and fuel supplies. They are available with outputs up to 800,000 B.Th.U. per hour and, if required, a hot water supply can be obtained by the fitting of an economiser. Units can be operated without heating in hot weather for air circulation.



Oil-fired, 500,000 B.Th.U.-per-hour space heater

A typical unit is illustrated herewith and it consists of a furnace chamber with a pressure jet burner, a fan chamber and a heat exchanger. The furnace gases are drawn into the heat exchanger, from which they pass through the flue stack to the atmosphere. The fan chamber is situated in the base and houses a low-speed, aerofoil fan, driven by a three-phase motor, and air can be drawn into it from either inside or outside the building. The air passing through an annular space between a refractory-lined combustion chamber and the outer wall of the unit is preheated before it enters the heat exchanger, where it attains its maximum heat. The hot air normally passes into the building through adjustable diffusers, but a ducting system can be provided for heating separate rooms.

Automatic devices fitted to ensure safety in operation include a flame failure control operated by a photo-electric cell, a thermostat which operates on air duct temperature.

† Enter No. E3642 on Reply Card.

Industrial and Labour Notes

Wages and Hours

In accordance with the decision taken at its recent annual conference, the Confederation of Shipbuilding and Engineering Unions has now formally submitted claims for wage increases and for a forty-hour week. The claim on behalf of workers in the engineering industry was presented, on Wednesday of last week, to the Engineering and Allied Employers National Federation. Mr. W. J. Carron, president of the Amalgamated Engineering Union, was the principal spokesman for the union. The claim, as formulated, was for a "substantial" wage increase and for a reduction of the normal working week from forty-four to forty hours. When asked by the Employers' Federation for a definition of "substantial," Mr. Carron intimated that the unions had in mind a wage increase of £1 a week.

Mr. Carron acknowledged that for the past year or so, the cost of living index had remained stable but went on to express the hope that that would not be used as a reason for saying there was no ground for a wage increase. He argued that, although real wages in the engineering industry had increased since the war, they had not done so to anything like the extent of the rise in productivity and profits, in the same period. The unions' view was that the time had come to register a real advance and to establish rates of wages in the engineering industry which would reflect the great increase since the war in the output of the workers and in the value of their labour. In support of the demand for a forty-hour week, Mr. Carron maintained that the employers had on several occasions declared themselves not to be against the reduction of the working week in principle. It was, he asserted, the management side of industry and not the unions which controlled the number of hours worked. The unions had offered to co-operate in reducing overtime, but it was obvious that managements had chosen to use it as the means of achieving production targets not attainable in a forty-four hour week. Nearly always, Mr. Carron claimed, there was a strong tendency for productivity to increase at an even faster rate when working hours were reduced.

Sir Kenneth Hague, president of the Engineering and Allied Employers National Federation, said that it would be necessary to seek the views of the Federation's member-firms. He hoped, however, it would be possible to reply on the claims in about six weeks' time. A reduction of four hours in the working week, Sir Kenneth pointed out, would mean a further addition to labour costs.

The claim relating to workers in shipbuilding and ship repairing was submitted on Thursday of last week to the Shipbuilding Employers' Federation. In general, it was on the same lines as that formulated for the engineering unions, though no specific definition of a "substantial" wage increase appears to have been given. At the meeting, the employers' representatives invited the union confederation's spokesmen to discuss the proposals for a new agreement about demarcation disputes in the shipbuilding industry (see page 330 of this issue). But the union representatives stated that the Confederation was not in a position to discuss the matter; they held that the employers should approach the individual unions.

British Standards Institution

The annual report of the British Standards Institution for the year ended March 31, 1959, comments on the growing demand of industry for new standards specifications on which to base production and purchasing requirements. The report says that, although the total number of new standards published was slightly less than in the preceding twelve months, there was a sharp increase in new projects to be undertaken in the technical divisions; in the engineering division 144 as compared with ninety-two last year; in the building division thirty-four compared with seventeen and in the chemical division forty-eight compared with sixteen. The range of the new projects has again widened. Products for which standards are now in course of preparation, at the request of industry, include seat belts for motorists, dividend warrants, poultry-feeding appliances and yacht rigging.

Unemployment

The Ministry of Labour has reported a fall in the unemployment figures in the four weeks ended September 14. On that date, there were 404,997 people (292,512 men and 112,485 women) registered as out of work in Great Britain. That was about 1·9 per cent of the total number of employees, compared with 2 per cent a year earlier. Of the total, 394,000 were described as wholly unemployed and 11,000 as temporarily stopped.

In the four-week period ended September 9, the Ministry says, the employment exchanges filled 179,000 vacancies. The number of vacancies notified to the exchanges, but still unfilled on September 9, was 255,000, which was 8000 fewer than in August.

The Size of Manufacturing Establishments

A size-analysis of manufacturing establishments in Great Britain with more than ten employees in April, 1959, has been made from figures of employment obtained from returns rendered by employers under the Statistics of Trade Act, 1947, and has been published by the Ministry of Labour. The last analysis of this kind made by the Ministry related to December, 1955, and was published in the *Ministry of Labour Gazette* for December, 1956. The total number of establishments with more than ten employees in manufacturing industries in Great Britain in April, 1959, was 55,739, compared with 56,313 at the end of December, 1955. The number of establishments with less than eleven employees is not known, but it is thought to be in the region of 150,000.

The Ministry's analysis breaks down the figure of 55,739 establishments with more than ten employees into nine size-ranges, and shows that there were 14,874 where the number employed was between eleven and twenty-four; 14,625 with between twenty-five and forty-nine employees; 11,520 with between fifty and ninety-nine; 8759 with between 100 and 249; 3293 with between 250 and 499; 1524 with between 500 and 999; 742 with between 1000 and 1999; 328 with between 2000 and 4999; and seventy-four establishments employing 5000 or more people. The analysis shows, the Ministry's report continues, that well over 50 per cent of the total number of establishments with more than ten employees were in the eleven to forty-nine size group, but that they employed only 10 per cent of the total number of employees, whilst one-third of the total number of workpeople were in establishments with 1000 or more employees.

The number of establishments coming within the "engineering, shipbuilding and electrical goods" group was 9089. This total is made up of 2164 establishments employing between eleven and twenty-four people; 4015 with between twenty-five and ninety-nine; 2132 with between 100 and 499; 383 with between 500 and 999; 270 with between 1000 and 1999; and 125 establishments with more than 2000 employees. The total number employed in this group was 1,848,000.

Overseas Trade

According to provisional figures issued by the Board of Trade, the values of United Kingdom exports and imports in August were both less than in July. Exports were valued at £255,500,000 and imports at £305,200,000. Re-exports were unchanged at £9,300,000 and the visible trade deficit was reduced from £55,800,000 to £40,400,000. A month-by-month comparison with last year is invalid, the Board of Trade says, because of the effect of last year's dock strike, but it appears that recent months' figures have been 7 or 8 per cent above the trend of a year ago.

Discussing the commodity pattern of trade, the Board states that the trend of exports has been rising since the beginning of April, and that the increase has mainly been in engineering products where the value of exports has risen by 8 per cent. Cars accounted for nearly half of this rise. Exports of machinery other than electrical were 8½ per cent up, but there was a drop in textile machinery. The exports of electric machinery appliances and apparatus increased by 5½ per cent, railway vehicles by 12 per cent, in spite of a reduction in carriages and wagons and parts, road vehicles and aircraft by 11 per cent, although exports of aircraft and parts went down, and exports of scientific instruments went up by 6 per cent.

Iron and Steel

The Iron and Steel Board has announced changes of detail in some of its maximum price schedules.

Certain weight and quality extras chargeable by plate producers have been reduced. Minor changes have been made in alloy forging ingot extras applicable to special purpose steels. The extras chargeable for small quantity sales by producers trading as stockholders have been increased in some cases. Alterations have been made in the basic, hematite and foundry iron schedules, and in particular prices will in future include delivery from railway stations to works without additional cost to consumers.

The formula under which the prices of strip mill tinplate are varied in accordance with the average price of tin has been modified so as to eliminate narrow changes in the prices of tinplate. In consequence, the prices of strip mill tinplate which would have risen on October 1 under the previous formula has not now done so. Maximum price control has been removed from the relatively small quantities of tinplate, tinned sheets and blackplate still produced in hand mills.

European Machine Tool Exhibition

No. III—(*Concluded from page* 233, *September* 25)

ONE of the equipments exhibited by Taylor, Taylor and Hobson, Ltd., of Leicester, was the model 50 "Talyrond" machine which is fitted with the new table and is designed to measure and record automatically the roundness of workpieces to 0·000,003in (0·075 micron). This equipment gives a magnification range from × 50 to × 10,000. It provides means for the filtering out from the graph of either the irregularities or the general errors of shape so that faults can be closely analysed. In connection with this class of equipment, it is of interest to note that the firm has developed a roundness testing head which can be fitted on such machines as jig borers to suit them for co-ordinate testing functions.

A number of new accessories have been introduced for use on the "Talysurf" instrument, used for surface inspection purposes in the standards room. As is generally known, the readings of this instrument are taken on a graph recorder on which there is shown a representation profile of surface irregularities, and on an average meter which gives the centre-line average index of irregularities on a predetermined surface length. For this instrument there are amongst other things now available a small bore pick-up for bores down to $\frac{1}{8}$in diameter ; a high resolution pick-up for surfaces of such things as precision slip gauges ; and a right angle attachment which turns the stylus through 90 deg.

The Taylor, Taylor and Hobson continuous gauge, or "Flying Micrometer" used in cold rolling mills to give a continuous reading of strip thickness to within 0·0001in has been further developed. This new instrument automatically maintains the roll gauge setting within set limits during the rolling operation by transmitting correcting signals to the mill screw-down motors.

A development from the heavy duty vertical milling machine made for some time by Droop and Rein, Bielefeld, Germany (Elgar Machine Tool Company, Ltd., 172, Victoria Road, London, W.3), is the universal milling machine shown in Fig. 17. The new machine can be readily adapted for various forms of milling by the fitting of attachments on the main head. This head has a vertical movement of 27½in on the column and its spindle has seventeen speeds, from 17 to 1800 r.p.m. The table, with a working surface of 86½in by 31½in, is driven by an independent 5 h.p. motor through a P.I.V. unit, giving a stepless range of feed speeds from ½in to 22in per minute ; a rapid traverse speed of 70in per minute is also available.

The head has stepless vertical feed rates between $\frac{1}{16}$in and 14$\frac{5}{8}$in per minute and a rapid traverse speed of 47in per minute. As illustrated, the head is equipped with its arm providing the support means for a heavy horizontal milling cutter spindle. The other attachments provided for the head include a heavy duty vertical milling head, with an axially adjustable spindle ; and a swivelling milling head which fits directly over and is driven from the main spindle.

As was to be expected, several makers of lathes demonstrated the very high rates of metal removal obtainable with ceramic tools, although this material is still in its relatively early stages of development and has made but little impression on the market for tungsten carbide tooling. Amongst the demonstrations of interest were those arranged for its "SPK" ceramics by Feldmühle Sudplastik und-Keramik G.m.b.H., of Plochingen, Germany. On this firm's stand cast iron was being turned, using spindle speeds of about 1000 r.p.m. with a feed rate of between 0·002in and 0·006in per revolution, the depth of cut being 0·10in and the cutting speed some 1150ft per minute. Steel to S.A.E. 1010 was being turned at 1000ft per minute with a feed rate of about 0·008in per revolution and a depth of cut of 0·10in. No coolant was being applied in either case and standard good quality high-speed lathes were used. These "SPK" tips are clamped mechanically and have up to eight cutting edges. Normally the standard tips have a 0·008in wide protective land on each edge offset at 30 deg. to the cutting face. These standard tips are unsuitable for feeds below 0·006in per revolution and cutting depths below 0·008in.

To show the possibilities of high production rate turning with ceramic tools, George Fischer, Ltd., Schaffhausen (Vaughan Associates, Ltd., 4, Queen Way, London, W.1), exhibited a "KDM-II" machine turning a brake drum. This machine has been specially adapted to provide the rigidity and improved performance necessary to take full advantage of the tooling. It is capable of average cutting speeds of 1200ft per minute on cast iron, using a depth of cut of 0·1in and a feed of 0·14in per spindle revolution.

An addition to the well-known range of Fischer "KDM-II" machines are machines fitted with two or three lower copying slides. This use of multi-slides makes for reduced turning times, the simultaneous run-through of a number of operations, and the finish turning of a complete workpiece in one clamping. The copying slides can be moved horizontally and fixed in either the vertical position or at any angle up to 30 deg. to the left, to adapt them to the requirements of the work. Each slide is controlled from a separate template and hydraulic power for slide operation is supplied from a pump driven from a 6 h.p. motor. By the use of pick-off gearing, a feed range in four series covers feed rates from 0·002in to 0·040in per spindle revolution.

The multi-slide machine exhibited was fitted with one of the firm's universal automatic loading and unloading equipments and engaged in turning from the rough a forged rear axle shaft. This loading equipment operates in conjunction with a conveyor on which workpieces are moved forwards in step with the machine cycle to present blanks to the loader. If the supply of blanks is interrupted to prevent the loading operation being effected, the conveyor is moved forwards under automatic control until the loading arms can pick up a blank, whilst the machine cycle is held in abeyance. Recently the firm has also introduced a threading attachment for use on its copying machines, and this enables threads from 4·25 to 25 T.P.I. to be cut on components from 1·2in to 4·7in diameter.

An interesting new development of Mikron S.A., Bienne, Switzerland (Matchless Machines, Ltd., 18, Bolton Street, London, W.1), is a range of hobs in tungsten carbide made to the same degree of precision as its high-speed steel ground form tools. These solid tungsten carbide hobs have fifteen flutes and a top rake angle of 6 deg. The firm is now able to supply all hobs for involute tooth shape with diameters from 0·7in to 1·6in and 80 to 12 D.P., made in solid tungsten carbide. Thread milling cutters of the same material are made in diameters from 1·25in to 2in, whilst it is expected in the near future to make available hobs for finer D.P.s, and for epicycloidal tooth forms.

The firm points out that the increased cost of these hobs can be justified where large batch production and high precision is required. The

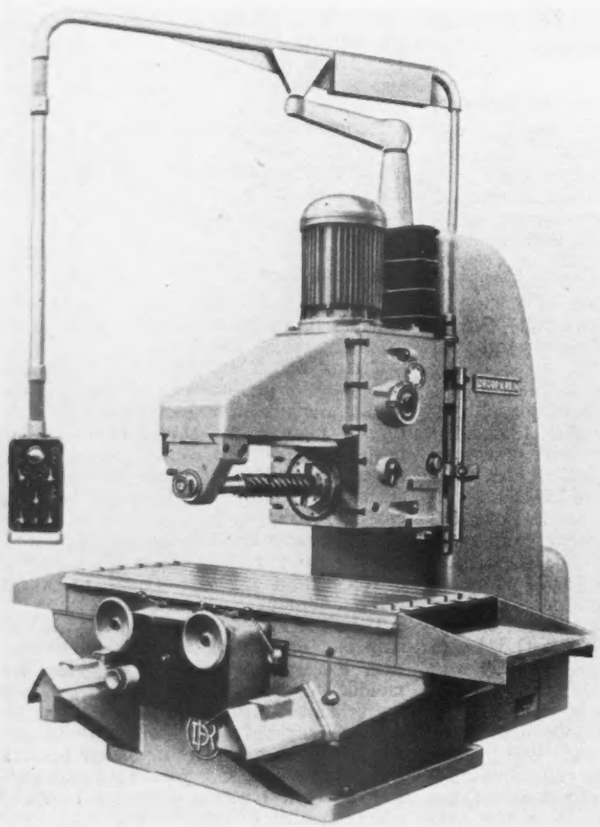


Fig. 17—Heavy duty universal milling machine—Droop and Rein

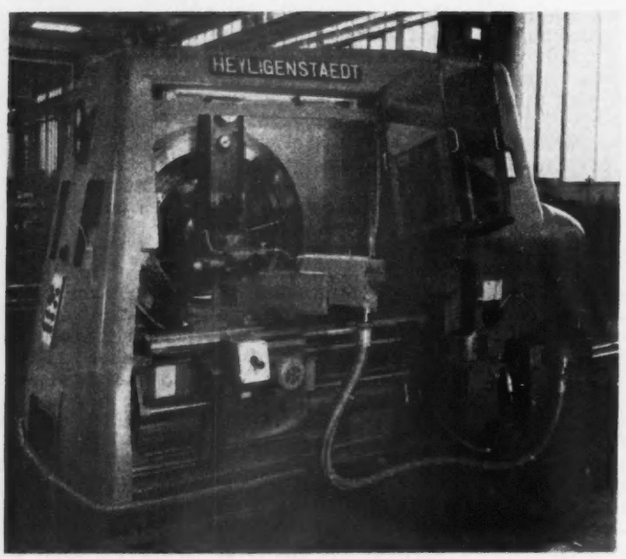


Fig. 18—Twin-copy turning machine for work up to 1m diameter—Heyligenstaedt

hobs can be used on all Mikron machines, providing backlash has been reduced to a minimum and sufficient power and speed are available, whilst specially strengthened work-holding fixtures are necessary. The makers state that in some cases it would be necessary for potential users of the hobs to purchase new machines specially designed with the required power capacity and high speeds required to take fullest advantage of tungsten carbide. It is claimed that, compared with high-speed steel hobs, production times with the new tools are reduced to about a sixth when hobbing steel, and up to a tenth when hobbing non-ferrous metals and non-metallic materials. Tool life between resharpenings is increased by six to ten times when cutting steel; ten to fifteen times when hobbing cast iron; and by more than twenty times when hobbing non-metallic materials.

A machine demonstrating production with the tungsten carbide hobs at the exhibition was hobbing forty-five teeth on a 58·75mm outside diameter gear 10mm wide, the D.P. being 1·25 and the diametral pitch 56·25mm. With a spindle speed of 1500 r.p.m. and a feed of 0·3mm, the cutting speed for these gears was 150m per minute, giving a production time of three minutes fifteen seconds per gear.

A twin-copy turning machine which simultaneously profiles both sides of work up to 1m diameter exhibited by Heyligenstaedt and Co., Giessem, Germany, is shown in Fig. 18. It is particularly designed for turning thin-walled discs such as those used for compressors on jet engines. The work is clamped in the machine round the circumference and this, it is stated, enables walls of down to 1mm thick to be produced true to shape.

A considerable amount of interest was shown by visitors to the exhibition in the "electrolytic carbide precision grinding machine" developed by Ateliers des Charmilles S.A. Geneva, Switzerland (Matchless Machines, Ltd., 18, Bolton Street, London, W.1), for sharpening and forming sintered carbide tools. This process differs completely from spark erosion as it is based upon a localised and controlled electrolytic dissolution of the material being ground. In the "grinding" process the electrolytic dissolution is obtained by passing a high-density current (as much as 100A per square centimetre) from the workpiece to a special rotating grinding wheel which is covered by a thin film of grinding fluid. The fluid consists of an aqueous solution of salts forming a so-called electrolyte, i.e. the fluid is electrically conductive. The workpiece is connected to the positive and the wheel to the negative leads of a d.c. supply, thus forming an anode and cathode.

Electrolytic dissolution is too complicated a process for us to go into detail in these notes, but it can be said briefly that the passing of a current between the workpiece and wheel is accompanied by a progressive dissolution of the workpiece (or anode) which is in contact with the wheel (or cathode). This process of dissolution of the anode can be likened to the reverse of depositing metal on the cathode, as is the case with metal plating by galvanic action. In that process the ions present in the solution are drawn towards the cathode where they take up one or more electrons and finally form a metallic precipitation. In the Charmilles process, however, the material dissolved from the workpiece is not precipitated on the cathode (grinding wheel), but is carried away in solution by the grinding fluid in the form of salts and oxides that no longer bear any resemblance to their metallic origin.

Wear on the special wheels used in this grinding process is stated to be very small and the speed of metal removal is stated to be five to ten times greater than any other grinding process for hard metals. In demonstrations metal removal rates between 200 and 1000 cubic millimetres per minute have been attained, depending upon the material. A high standard of surface finish is attained and there are stated to be no surface cracks or changes in the surface structure of materials after grinding.

In addition to a new high precision cylindrical grinding machine for work up to ¾in diameter and 10in long, the firm of Fritz Studer, Ltd., Glockenthal-Thun, Switzerland (Matchless Machines, Ltd., 18, Bolton Street, London, W.1), showed one of its template-controlled profile grinding machines equipped with the recently developed "Dictator" control. With this control device uniform feed is applied automatically in all directions without attention from the operator of a machine. Another instrument shown by this firm was the "Movolimit" electronic-mechanical measuring and control equipment for cylindrical grinding machines. During grinding, the decrease in diameter can be followed on an indicator, on which, when using the measuring range of ±0·0002in, a distance of approximately 1in on the scale represents 0·0001in.

In the case of repetition work on the firm's hydraulic cylindrical grinding machines, the equipment automatically controls the stages of the grinding operation relative to the diameter of the workpiece. Wheel wear does not have to be considered, as gauging takes place on the diameter of the workpiece.

Also to be seen on this firm's stand was the "Deltalimit" equipment for use on cylindrical grinding machines and which enables shafts to be ground to fit a given bore with a specified clearance. For this purpose the workpiece with the ground bore is placed on the measuring arbor of the internal measuring equipment. The grinding of the respective shaft can then be effected automatically, in that the movements of the cylindrical grinding machine are controlled as a function of the diameter of the bore and the preset required clearance. Deviations of the bore from the nominal diameter are thus automatically taken into consideration. The equipment is stated to be particularly suitable in cases where tolerances in the order of 0·00004in (0·001mm) are stipulated for the clearance.

Two production grinding machines fitted with work loading equipment were exhibited by Gendron Freres SA., Villeurbanne, France (Stanley Howard, Ltd., 73, Devon Street, Birmingham, 7), and each of these machines had an improved design of the firm's hydraulic motor drive to their wheelheads. In these new wheelheads there is provided a speed ratio from 2in per second to 0·00004in per second, and a quick-acting solenoid valve is stated to stop the wheelhead slide within a tenth of a second during in-feed. The type "RA16" machine illustrated in Fig. 19 was equipped with an automatic

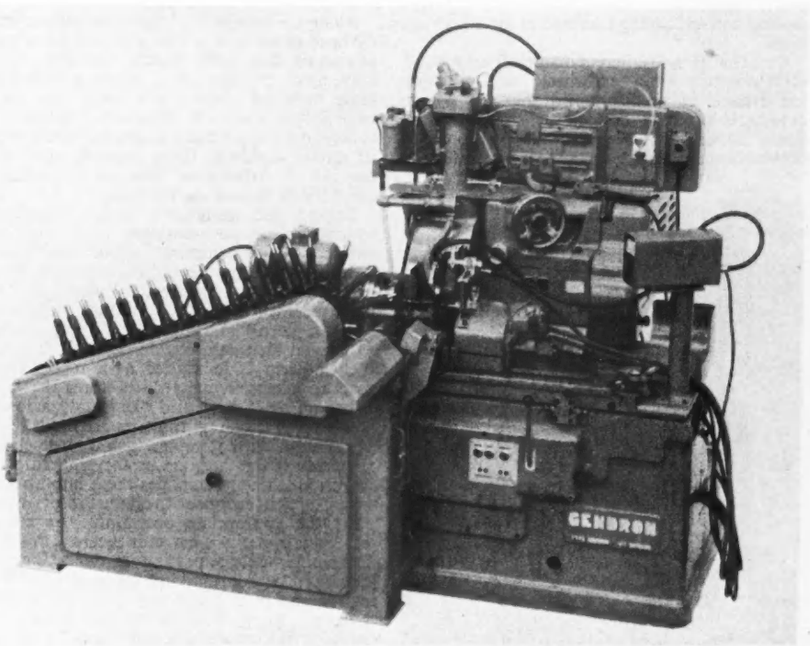


Fig. 19—Grinding machine with automatic loading and unloading equipment for gear shafts—Gendron

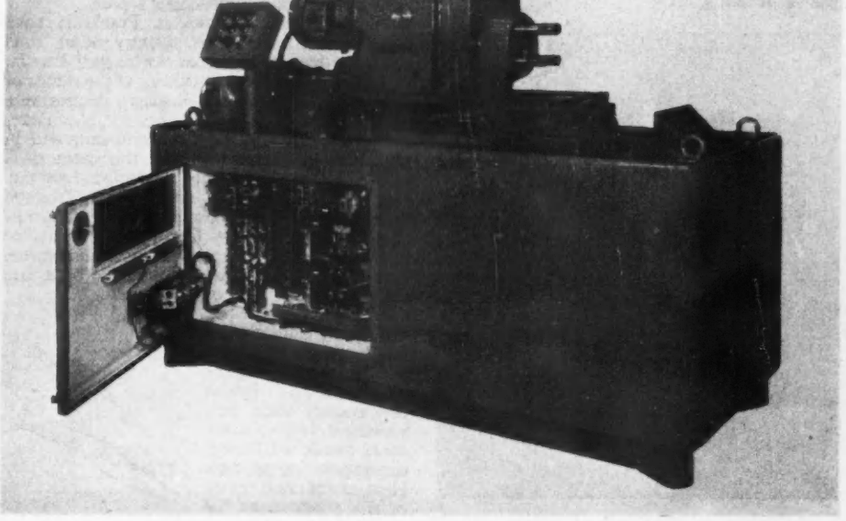


Fig. 20—Asquith unit head equipped with "Bi-Stat" control

loading and unloading mechanism for a gearbox shaft.

On this shaft two different diameters are ground simultaneously using two wheels, both of which are dressed at predetermined intervals by an automatic profiling device. A stop-gate self-sizing instrument is automatically positioned to check diameters during the grinding operation.

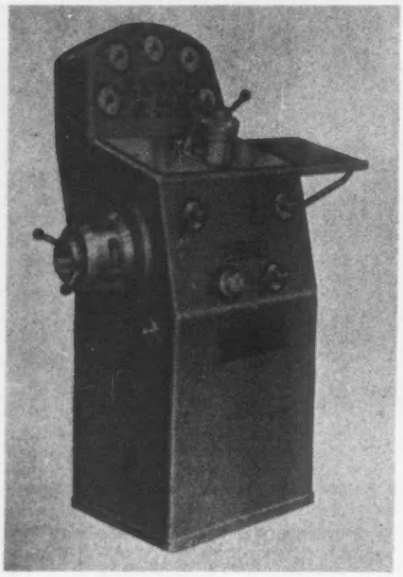


Fig. 21—Erichsen 40-ton automatic cup-testing machine for sheet metal, fitted with a 100-ton blanking press attachment for producing specimens

A demonstration equipment arranged by Brookhirst Igranic, Ltd., of Bedford, showed the application of the "Bi-Stat" control to an Asquith screw feed unit head, as illustrated in Fig. 20. The unit comprises a head which is traversed along its bed by a lead screw and has provision on its front face for the mounting of multi-spindle or other attachments. A motor at the rear of the head drives the spindle through gearing and the feed taken from the spindle drive through slip gears and a final worm and wheel driving a nut on the stationary lead screw. The "Bi-Stat" equipment is designed to control the standard operations of the machine according to the programme set up for an integrated line of heads or the sequences of a transfer or special purpose machine. The control units translate the commands given by operator's push-buttons into operation of the motor contactors in a predetermined sequence. These sealed control units have no moving parts and need no maintenance or setting up.

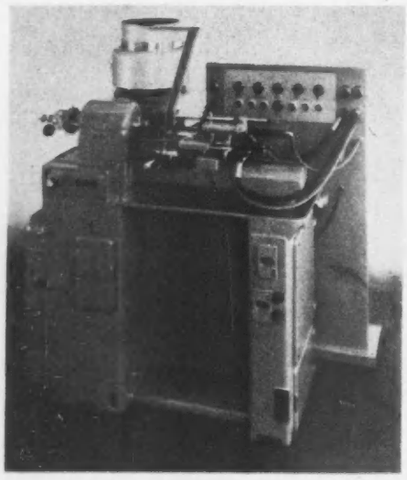


Fig. 22—Boley automatic finish turning lathe with magazine feed

Along the side of the transverse bed on which the head slides there is fitted a slotted bar carrying adjustable trip arms which, operated by the movement of the head, actuate "Bi-Stat" units mounted immediately under the bar to control the cycle of operation. These units collect and report facts about the machine and its cycle, compare them together and effect control of subsequent motions according to conclusions reached on the facts.

During the machining cycle, transducers, which replace push-buttons, limit and other switches in this equipment, report facts such as "the head has now reached the slow feed forward position." What are termed "and" or "or" units receive these facts, sort them and forward them, a given "and" or "or" being equipped to present facts in a certain pattern. The complete pattern is forwarded as a report on the facts to a trigger unit, which stores the report. When all the "and" and "or" units associated with a given trigger unit have reported to it, it compares the facts they report with a predetermined pattern. If the facts are as they should be, the trigger electrically amplifies them into an action signal which energises a contactor or relay to start the appropriate operation. In the case of timed cycles a timer unit receives this signal and either delays passing it on or limits its duration according to a preset interval. When, at the end of a machining cycle, the head has returned to its normal starting position, the sensory transducers and the "and" and "or" units are returned to their normal conditions.

A fully-automatic sheet metal testing machine was shown by A. M. Erichsen, G.m.b.H., Hemer-Sundwig/Westfalen, Germany (Pearson Panke, Ltd., 1–3, Hale Grove Gardens, London, N.W.7). This machine (Fig. 21) is supplied in three versions for 12, 20 and 40 tons drawing pressure. In each case the drawing pressure range is subdivided into three zones, so that accurate results can be obtained from the thinnest to the thickest sheets. The 12-ton model can be employed for the fully-automatic Erichsen cupping test to the following standards: Draft ISO/R 209; Euronorm 14–58; DIN 50 101; NF A 03 602 and NF A 03 601 (Persoz). The 20 and 40-ton models can be employed in addition for automatically carrying out the deep drawing cup test (including the Swift test), and also the deep drawing bore expanding test.

On this machine all that is necessary is to insert the sheet metal specimen and to operate a press button, and the test result is printed on a paper ticket. The new machine rapidly effects the following operations: clamping of specimen under preset constant sheet holder pressure; deep drawing at a preselected drawing speed; stopping of drawing punch at specimen failure; registration of depth value on a counter; printing the reading on a paper ticket. It then returns to the starting position and releases the specimen.

The machines for 20 and 40 tons maximum drawing pressure may be equipped with hydraulically-driven blanking press attachments of 40 and 100 tons pressure respectively, to stamp out the circular blanks needed for the deep drawing cup test.

A precision production lathe has been introduced by G. Boley, Esslingen/Neckar, Germany (Burton Griffiths and Co., Ltd., Kitts Green, Birmingham, 33), which is available with a series of interchangeable units to adapt it for various types of production. One of these lathes with a magazine feed and intended for finish turning parts, produced on automatics, is illustrated in Fig. 22. In this case the tailstock spindle is used to push the parts into a compressed air operated chuck from the magazine boot.

The longitudinal and cross slides on the saddle are hydraulically actuated to fixed stops and movements of the machine when working on an automatic cycle are controlled by solenoid-operated valves. The automatic sequence of machine movements is set by appropriately positioning rotary switches on the control panel, to be seen on the cabinet at the rear of the machine.

International Motor Show at Frankfurt

No. III—(*Continued from page* 320, *September* 25)

IN our last issue, in which we dealt entirely with German motor-cars, we pointed out that the number of foreign cars at Frankfurt had been considerably greater than that of German makes. In view of this, and the further fact that most of these exhibits will eventually be seen in Paris and London, we refrain from a detailed description of their specifications and mention only some of their most notable new aspects.

All British cars shown at Frankfurt have been announced in this country some time back and can be presumed to be well known. Great public interest was evident at the stands of Jaguar, M.G. and Austin-Healey; dealers were confident that there was a considerable market for fast sports cars on the Continent, and in particular in Germany, where this category is only represented by the air-cooled 1500 c.c. and 1600 c.c. Porsche cars. The Triumph "Herald" also received a great deal of favourable comment as the first quantity-produced British car with independent rear suspension. The adoption of this design principle by a firm associated with one of the "big four" British motor manufacturers was taken as an indication that the allegedly "conservative" British constructors were now viewing more favourably some trends of European engineering practice. Here, as well as in the case of the products of the British Motor Corporation, the beneficent influence of Italian body styling on the appearance of the latest models was generally appreciated.

The new Austin "Seven," though widely publicised in Germany, seemed to attract the public to a lesser degree than one would have expected. Though the passenger comfort was considered quite adequate for a car of very small overall dimensions, the opinion was frequently voiced that its square and rather austere appearance did not compare favourably with that of similar European cars in the same price bracket. On the other hand, the Austin stand was always surrounded by experts and students of automobile engineering, eager to examine the original layout and the clever detail design. Competent engineers and many motoring correspondents of the German and foreign press frankly declared that the new car (the design of which is said to have been conceived about ten years ago) could easily have conquered the whole European market had it been introduced five or six years earlier. To-day, the Austin "Seven" will have to compete on equal terms

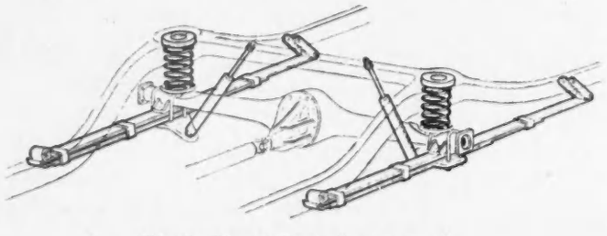


Fig. 10—Simca "Aronde" rear suspension

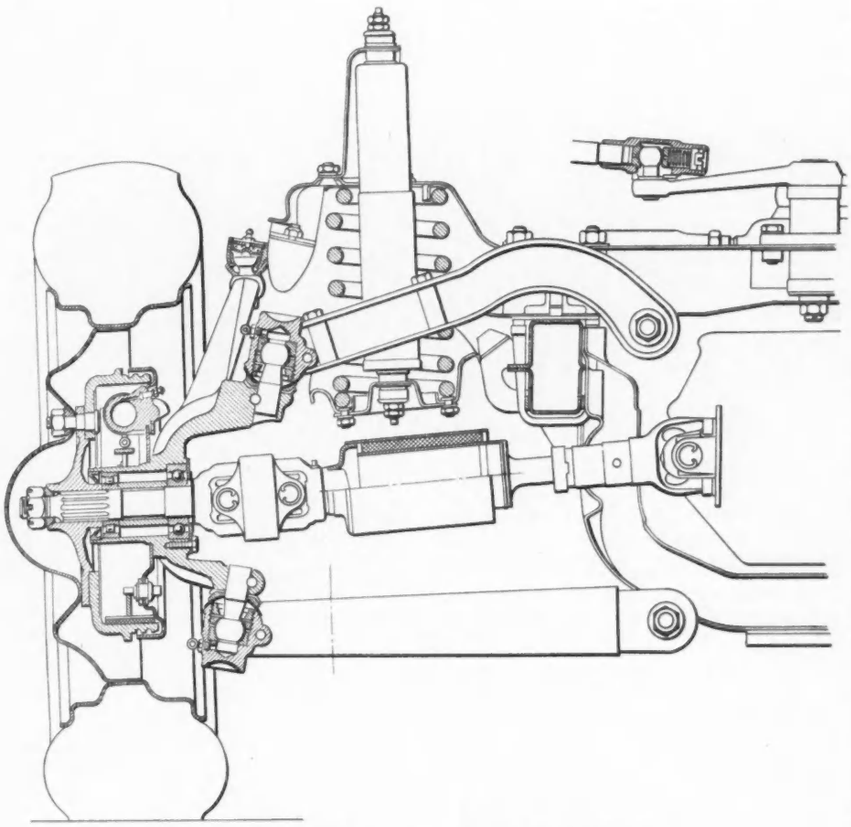


Fig. 11—Independent front suspension of the Renault " Estafette "

with several well-established makes of front-wheel-drive and rear-engined cars, and its sales appeal will probably depend not so much on its undisputed technical merits, but to a great extent on an attractive price.

Turning to the French exhibits, we noticed at the stand of Renault a sports version of the well-known "Dauphine," the new 850 c.c. " Gordini," which has a four-speed gearbox and a modified engine of the same cylinder capacity. By improving the induction system and the valve operating mechanism, and by increasing the compression ratio from 7·25 : 1 to 8 : 1, the output of the engine has been raised from 35·5 h.p. to 40 h.p.

All cars of the " Dauphine " class are now equipped with the so-called " Aerostable " auxiliary spring elements. At the front, hollow rubber springs, each having two convolutions, are arranged inside the coil springs between the lower wishbones and the damper. At the rear, sealed air cushions, each comprising a two-piece steel housing with a rubber diaphragm clamped between the two parts, are interposed between the swinging half-axle tubes and the body structure. The purpose of these auxiliary springs is to provide, in conjunction with softer coil springs, a progressive spring rate, giving a softer ride when lightly laden and a gradual stiffening of the springing when more weight is carried. The frequency of the springs is said to remain fairly constant over a wide range of load variations.

Another system of auxiliary springs is employed by Simca in their 1·3-litre cars. Here the orthodox live rear axle is carried and located by conventional semi-elliptic leaf springs ; coil springs, interposed between the axle tubes and the frame structure, help to give progressive strengthening under load (Fig. 10). The addition of auxiliary coil springs to leaf springs reduces the inter-leaf friction of the latter.

The Italian section offered the visitor little of interest : Fiat cars in particular are sufficiently known as the two rear-engined models " 500 " and " 600 " are being assembled in Germany at the rate of about 23,000 units per year by the N.S.U. Automobil A.G. at Heilbronn. Here, as well as in other Italian cars, alterations were mainly confined to styling and detail modifications. Public interest, however, was attracted by a beautiful Ferrari sports coupé, styled by Farina, having a 3-litre " Vee "-twelve-cylinder engine of 240 h.p. The car on view is one of the last twelve-cylinder cars still being built, and with a maximum speed of more than 155 m.p.h. is believed to be the fastest sports car in the world.

American cars did not seem to attract the public to any great extent ; quite apart from the fact that, by reason of their excessive size and their high fuel consumption, they are not particularly suitable for European conditions, they are a familiar sight on the Continent, many of them being used by the numerous U.S. officials and members of the American forces. The latest models exhibited at Frankfurt differed from those seen at last year's London motor show in small details only.

A foreign car which raised a great deal of interest, especially among experts, was the Volga " M 21," the first Russian car ever exhibited at one of the great international motor shows. The Volga, represented at Frankfurt in two versions, as a roomy four-door, five-seater saloon and as an estate car, is evidently designed to suit Russian climatic and road conditions, which necessitate a strong and reliable vehicle with a powerful engine and requiring a minimum of maintenance.

The Volga saloon is an attractive looking car of modern functional lines, free from all unnecessary ornamentation, but having such practical styling refinements as a curved windscreen and rear window, built-in, well arranged lamps, and a low sloping bonnet. The car, built in integral all-steel construction, has an overall length of 15ft 10in, a wheelbase of 8ft 10in and a mean track of 4ft 3¾in. Its curb weight amounts to 28 cwt. The front suspension is of the conventional wishbone and coil spring type, while the rigid, hypoid-drive rear axle is carried by semi-elliptic leaf springs. Hydraulically-actuated brakes with cast-iron drums are used at the front and at the rear, and a transmission brake at the tail end of the gearbox is provided for parking purposes. The car is normally fitted with a three-speed gearbox, having synchronisation of the two upper ratios and steering-column control ; an automatic transmission, comprising a hydro-dynamic torque converter and a three-speed epicyclic gear, is optionally available. In order to facilitate the maintenance, a central lubrication system is provided ; a foot-operated pedal, which should be depressed every 120 miles, feeds engine oil through a network of calibrated pipes to the various joints of the suspension and the steering linkage.

An interesting example of Russian engineering practice is the 2·5-litre o.h.v. four-cylinder engine of 92mm bore and stroke which develops 80 h.p. at 4000 r.p.m. The compression ratio of 7·5 : 1 is intentionally kept low for the purpose of utilising low-octane fuel.

The cylinder block as well as the cylinder head are light-metal castings, the block being fitted with wet cast-iron cylinder liners. The hollow cast-iron crankshaft is carried in five steel-backed lead-bronze bearings ; the camshaft is driven by straight spur gears, located at the front end, while the fan, the water pump and the dynamo are driven by a Vee-belt.

Great care has been taken to provide satisfactory operation and resistance to wear in dusty road conditions : there are two filters in the lubricating oil circuit—a full-flow filter and a by-pass filter. A large combined air-intake silencer and oil-bath filter is fitted at the top of the down-draught carburetter.

The Volga " M 21 " is likely to be exhibited next month at the London Motor Show, and on this occasion should be studied very closely by British automobile engineers. It provides an excellent opportunity of learning how the Russian designer approaches a clearly defined task ; it also gives a good example of his methods to achieve considerable savings of weight by the extensive use of light-metal castings.

Turning now to commercial vehicles, we note that, in contrast to the more international character of the motor-car display, the great majority of the exhibits in the commercial vehicle sector were of German origin. Foreign

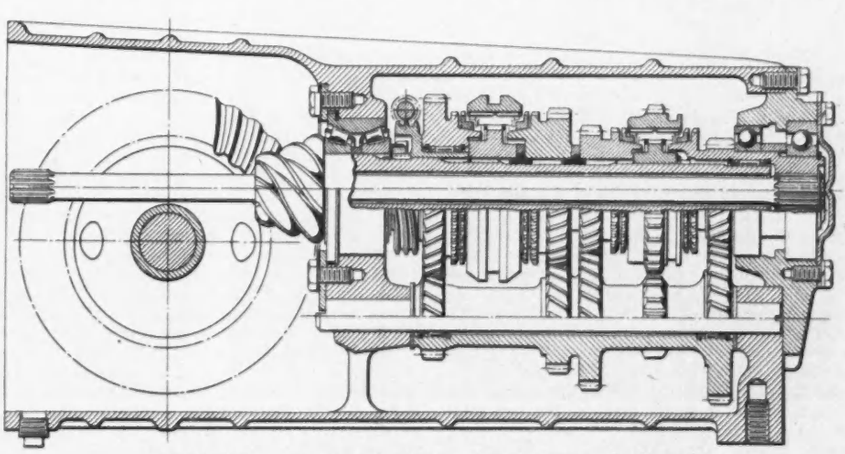


Fig. 12—Four-speed, all-synchronised gearbox of the Renault " Estafette "

participation was confined to some French, Dutch and Austrian light and medium-size vehicles and to several well-displayed exhibits of the British Rootes Group, which presented their latest Commer and Karrier models.

Before dealing with the heavier types of commercial vehicles, we should like to give a brief description of some examples which show the constructional tendencies governing the design of modern light and medium-size goods vehicles. We can neglect the great majority of delivery vans, pick-ups and so on which, being mainly made by the big manufacturers of motor-cars, closely follow the principles of car design, utilising as far as possible the same or suitably modified mechanical components. In one of our previous reports we pointed out that neither the rear engine layout nor the front-wheel drive offer any difficulties to the conversion of an existing motor-car into a light goods vehicle. On the contrary, the front-wheel-drive, in particular, is suitable for this purpose, as the forward position of the complete power transmission unit makes possible a low and unobstructed platform with an easy access.

Good examples of light front-wheel-drive commercial vehicles were displayed at the stand of Tempo A.G. (now amalgamated with the Hanomag A.G.), among them a 30 cwt pick-up with double cabin, a furniture transporter and a small bus " Matador " for the driver and twelve passengers. All Tempo vehicles have a backbone chassis consisting of two closely spaced tubular members and outriggers ; the front suspension employs wishbones in conjunction with a transverse leaf spring, the rear suspension has radius arms and coil springs. The smallest, 15 cwt, Tempo vehicle is fitted with a 20 h.p. twin-cylinder, two-stroke engine, the 20 cwt and 30 cwt vehicles have B.M.C. four-cylinder engines of 950 c.c. and 1·5-litre cylinder capacity respectively.

In case of vehicles with rear engine mounting, access to the loading platform is naturally restricted, but—as the various examples at the stand of V.W. showed—the difficulties are by no means insuperable. The Renault works have solved the problem of making a small front-wheel-drive transporter, the " Estafette," out of existing mechanical components by transferring the complete power transmission unit of the rear-engined

Fig. 13—Steyr-Daimler-Puch all-wheel-drive cross-country car with 650 c.c. air-cooled twin-cylinder engine

" Dauphine " to the front of a newly-designed chassis. The basically unchanged engine-transmission unit of the transporter is mounted on a sub-frame with the engine in front, and the gearbox behind the front wheel centres ; the torque is transmitted from the final drive to the constant-velocity joints of the wheels by half-shafts, equipped with strong rubber sleeves to take small torsional and longitudinal deflections (Fig. 11). The independent rear suspension has transverse wishbones and coil springs. An interesting detail of the transmission is the four-speed, all-synchronised, gearbox (similar to that of the " Gordini ") which, in contrast to that used in other front-wheel-drive and rear-engine layouts, allows a direct drive in the top ratio (Fig. 12). A long, torsionally flexible quill shaft passes through the hollow main shaft and is splined to the geared second motion sleeve. The main shaft, at its front end, carries the bevel of the hypoid gear, which is sufficiently off-set relative to the crown wheel centre to allow the quill shaft to clear the differential casing.

The " Estafette " is available as an open platform carrier for 12 cwt payload, as delivery van, and as a mini-bus, carrying the driver and nine passengers.

Among other light load carriers there was an interesting cross-country vehicle, made by the Austrian Steyr-Daimler-Puch A.G. It has four-wheel drive, weighs only 12 cwt, but is able to carry 8 cwt in the most difficult conditions and to climb gradients up to 65 per cent (Fig. 13). A horizontally-opposed, air-cooled, twin-cylinder engine of 650 c.c. capacity with an output of 22 h.p. at 4500 r.p.m. is mounted at the front of a chassis, having a tubular backbone and a stiff, pressed steel platform. The swinging half-axles at the front and rear are supported by coil springs and hollow rubber auxiliary springs, thrust and reactions being taken by inclined radius arms. The front and rear differentials can be blocked when negotiating soft or slippery terrain and an auxiliary drive from the gearbox allows the installation in the vehicle of such equipment as a winch, a pump or a compressor.

Light goods carriers up to 2 tonnes gross weight comprise about 38 per cent of Germany's total production of commercial vehicles, and vehicles from 2 to 4 tonnes gross weight account for another 21 per cent. A considerable number of the latter category are being made by some big manufacturers of motor-cars, especially by Opel and Ford ; these vehicles are generally equipped with petrol engines and, being made in large scale production, have not undergone any significant change since their appearance at the 1957 Frankfurt show.

The design of heavy goods vehicles, i.e. of those for payloads exceeding about 3 tonnes, is naturally more flexible, being less influenced by considerations of large-scale production methods. However, in this field, too, progress has been restricted to refinements and detail improvements, a fact which is by no means surprising, as the more drastic modifications, necessitated by the present German traffic regulations, had already been taken into account at the time of the 1957 Frankfurt show. What we were seeing at this year's exhibition was, to a great extent, a logical development of the trend apparent at the previous show, namely, the tendency to improve the net weight-to-payload ratio by constructional means, and to distribute the total laden weight of the vehicle in the optimum way to keep the maximum axle load within the legally permissible limits.

These tendencies lead automatically to the adoption of the forward or semi-forward control for practically all vehicles of more than 5 tonnes gross weight, and to the increased use of tractor-trailer combinations and six-wheelers for payloads of more than 8 or 9 tons. New on German roads is the appearance of six-wheelers with two steered front axles, a good example of which design was seen at the stand of Daimler-Benz (Fig. 14). It appears that in this respect the design principles of German heavy goods vehicles are now approaching very closely those practised in this country for some time.

Fig. 14—Mercedes-Benz six-wheel truck with two steered front axles

(To be continued)

Train Accelerations Follow Electrification

It is announced by the French National Railways that electrification of the 78 miles from Valence to Avignon has been completed in time for all main-line expresses to be electrically hauled between Paris and Avignon (461 miles) when the winter timetables come into force on October 4. This extension of the existing 1500V d.c. electrification from Paris (Gare de Lyon) will permit considerable acceleration of main-line trains between Paris, Marseilles, and the Riviera. The " Mistral " Paris–Nice express will run between Valence and Avignon at an average of 78 m.p.h. instead of 62½ m.p.h. as at present and will reach Nice fifteen minutes earlier with an average speed of 64½ m.p.h. for the whole journey of 676 miles. Work is in progress on electrification at 1500V d.c. from Avignon to Tarascon, and on the cross-country connection from Tarascon to join up at Nîmes with the electrified line to Toulouse and Bayonne.

Economics of Materials Handling

A three-day international course on " The Economics of Materials Handling " is being organised by the Research Institute for Management Science, Delft, to take place on November 25, 26 and 27. The theoretical course can be extended over a period of one to three weeks to cover a study of practical applications in industry.

The three-day course will be concerned with the analysis of handling costs, methods of recording and measuring costs, and the comparison of different handling systems in a variety of industries. It is considered that by its scope the course will appeal principally to plant managers, departmental heads, and consultants. The fee, exclusive of board and lodging, for the three-day course is 240 Fl. Persons interested are asked to write to the Course Secretariat, c/o R.V.B. Research Institute for Management Science, 76, Nieuwe Laan, Delft, The Netherlands (tel.: 26990).

Corrosion Research at the National Bureau of Standards

BY OUR AMERICAN EDITOR

To provide science and industry with solutions to some of the practical engineering problems encountered to-day, the National Bureau of Standards is investigating the primary processes of corrosion. Large, single metal crystals are employed in some of the research to correlate corrosion with the arrangement of atoms in the crystal lattice. The parts played by electrical phenomena and cathodic protection comprise a phase of the programme. One study deals with the nature and mechanism of formation of oxide films on metal surfaces. The effect of illumination on the corrosion reaction has also been studied. By attacking the problem from different directions, the Bureau's corrosion research staff hopes to improve the present methods of combating corrosion.

SINCE metals were first used for industrial purposes, man has waged constant warfare against the forces of corrosion. This complex process has been defined as the destruction of a metal by chemical or electrochemical reactions with its environment, and deterioration often proceeds in direct proportion to the aggressiveness of the environment. Corrosion is a serious and costly aspect of a country's economy. The continuous depletion of ore reserves is only one factor to be considered. Wages, the "down time" of equipment, and replacement costs must also be taken into account. It has been estimated that the annual cost of corrosion in the United States runs to many millions of dollars. Of course, exact figures on the total cost are not available, but in the underground pipeline industry alone, reliable estimates show the expense of replacement to be about 600 million dollars a year.

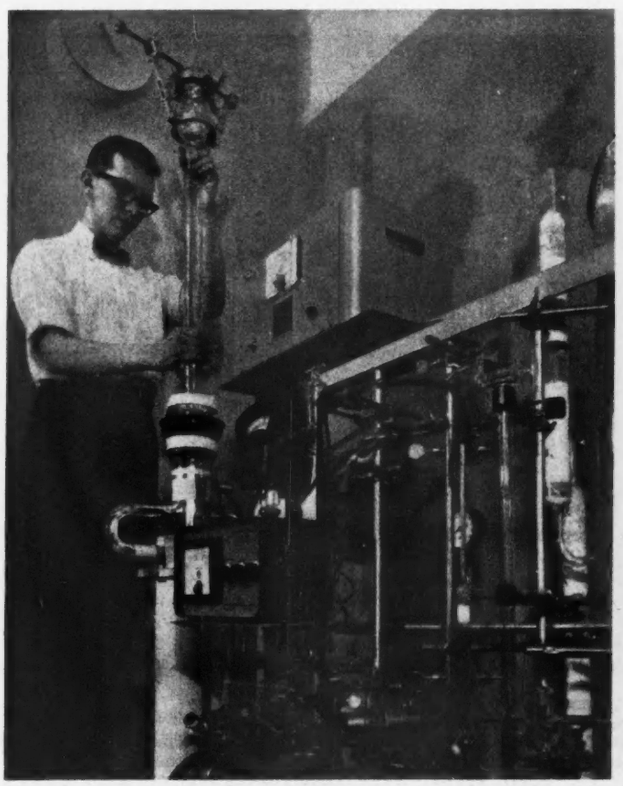
To aid in the solution of this problem, the National Bureau of Standards has for many years conducted a programme of research on the fundamental mechanisms of corrosion and the corrosion properties of materials. Now, under the direction of G. A. Ellinger, this programme emphasises basic processes and principles, seeking to discover why metals corrode and how corrosion can be prevented. The current studies deal with such topics as the corrosion reactions at the metal surface, electrochemical polarisation and other electrical phenomena associated with corrosion, the effects of free radicals on metals at low temperatures, the nature of corrosion in large, single crystals, and the mechanism of stress-corrosion cracking. By attacking the problem from these various directions, the Bureau hopes not only to improve methods of combating corrosion, but also to obtain basic data on the properties of matter that may be useful in other fields.

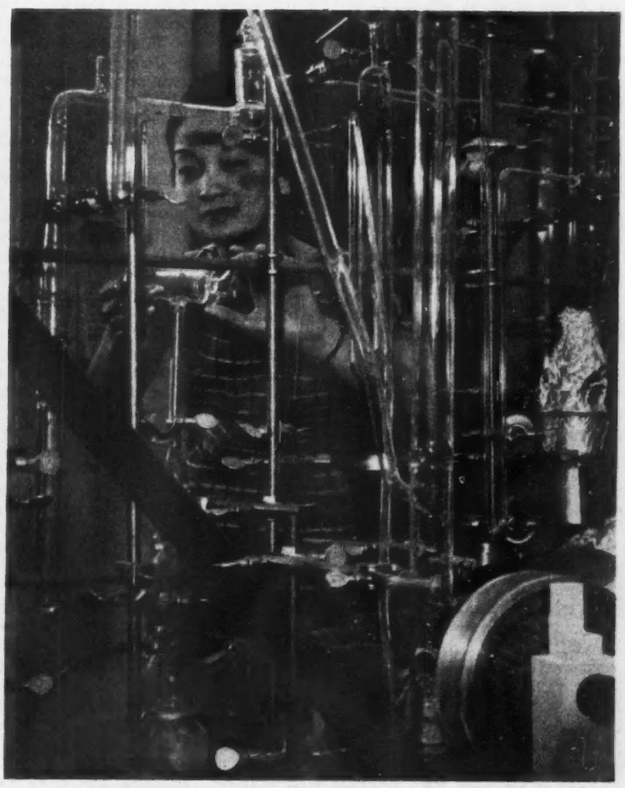
One of the first corrosion studies at the Bureau was on the "season cracking" of brass, a form of stress corrosion that affects the grain boundaries of brasses in a selective manner. Another early investigation, undertaken at the request of the American Congress, explored the electrolytic corrosion of steel by stray electric currents. This work developed into an extensive soil corrosion programme, which continued until 1952. More than 300 reports containing information gained during this effort have been summarised and published in N.B.S. Circular C–579, "Underground Corrosion." One long-range investigation, on the corrosion of aircraft alloys, was started during World War I, when metallic materials were first considered for aircraft, and is still continuing under the sponsorship of the Bureau of Aeronautics, U.S. Department of the Navy.

Single Crystal Studies

As the corrosive process is influenced by many factors, a study of metals in their commercially usable state affords little information on the fundamental nature of the process. Such information can best be derived by studying the least complex form of the metal that has the basic characteristics of the whole, i.e. metal in the form of single crystals. In this way, many of the corrosion-influencing factors of polycrystalline materials can be isolated and reproducible results can be obtained. Single crystals are being used in research initiated at the Bureau in 1955 under the sponsorship of the Corrosion Research Council. Chosen to investigate the adsorbed layers that form on metal surfaces was the metal-water-oxygen system. Copper was selected as the metal because it has a face-centred cubic structure, is readily available in high purity, and the corrosion products formed are few and simple.

Spherical specimens were initially employed in this work because they permit all of the crystallographic planes to be studied simultaneously. When carefully cleaned and polished specimens are exposed to water containing oxygen, different oxide interference colours appear on the various planes. Each colour is readily identifiable from the patterns that are formed and indicates a different rate of growth of the corrosion products. In one study experiments were carried out both in open vessels exposed to the atmosphere and in a closed all-glass apparatus in which the surrounding atmosphere and purity of the water were rigidly controlled. The differences in the composition and nature of the films that formed on similar specimens were attributed to the presence of carbon dioxide in the laboratory atmosphere in the first experiment, and its absence under the controlled conditions of the second. During this study it was discovered





Figs. 1 and 2—(Left) Study of the effect of atomic oxygen on metals at low temperatures conducted by means of liquid helium apparatus within N.B.S. free radicals research programme. (Right) Determination of electrical potential necessary to protect copper cathodically from stress-corrosion cracking

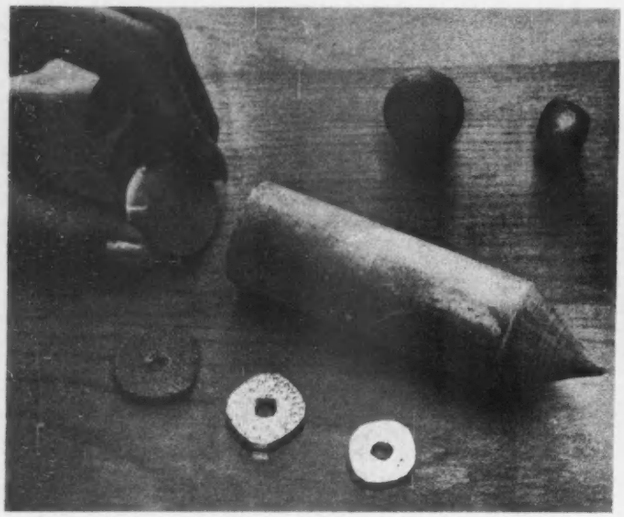


Fig. 3—Determination of the effect of crystallographic orientation on rates of corrosion of a single aluminium crystal cut into disc specimens

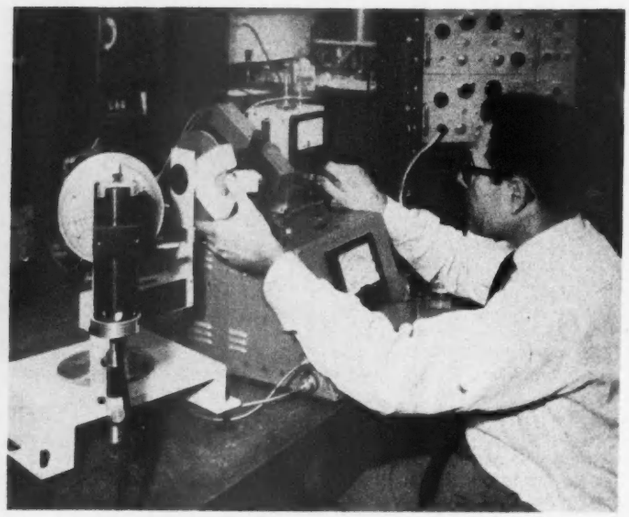


Fig. 4—Film thickness measurements with a polarising spectrometer to determine surface corrosion of single metal crystals

that light has a marked inhibiting effect on the corrosion process.

A related effort undertaken as part of the Bureau's free radicals research programme, is concerned with the influence of atomic oxygen on metals at low temperatures. In this work, oxygen is made to pass through a microwave discharge in order to dissociate some of the oxygen molecules. Initial experiments indicate that some reaction does occur between atomic oxygen and copper crystals cooled to 4·2 deg. Kelvin. No reaction occurs, however, with oxygen which has not been passed through the microwave discharge. This area of investigation is expected to produce interesting and fruitful results. In these single-crystal studies, a polarising spectrometer is used to observe and measure the rate of film growth. This instrument has also been found useful in obtaining data from which the index of refraction of thin gas films can be calculated.

Other work with single crystals has been conducted to study the relationships between surface atomic arrangement and rates of corrosion in acids and alkalis. When large single crystals of high-purity aluminium were exposed to an acid mixture, the configuration of the etch pits that formed on the surfaces differed according to the crystallographic orientation of the specimen. The rates of corrosion on these surfaces varied radically from the rates observed on atomically similar surfaces exposed to an alkali mixture. The cylindrical specimen shown in the accompanying illustration is an aluminium single crystal grown in a vertical furnace at the National Bureau of Standards. Specimens in the form of discs, like the one held to the left, are cut from the crystal and subjected to corrosive media to determine the effect of crystallographic orientation on rates of corrosion. The different shapes into which the specimens corrode (foreground) depend on both the orientation of the specimen and the corrosive medium. The spherical specimen corrodes in the shape shown to the right when exposed to an aqua regia-hydrofluoric acid mixture.

During an experiment with the corrosion of monocrystalline copper in an acid, copper was electro-deposited on the specimen surfaces in an attempt to distinguish more readily the facets exposed as a result of attack by the acid. An analysis of Laue back-reflection diffraction patterns showed that the microstructure of the deposit either duplicates the orientation of the base crystal or has a continuing and twinned relationship with it. During the course of this research, equipment was developed for growing preferentially oriented metal monocrystals of practically any cross-sectional shape. A preselected orientation was obtained with a technique known as "seeding," and the desired cross-sectional shape was produced by growing the crystals in a vertical furnace.

Galvanic Corrosion

Even the purest metals have many foreign atoms within their lattices. Less pure metals contain non-metallic inclusions, metallic impurities and other inhomogeneities. Exposure to a corrosive medium of dissimilar metals in contact with each other, or of a metal with surface inhomogeneities causes galvanic or electrochemical corrosion. Such corrosion can also occur on metal surfaces exposed to non-uniform electrolytes with variations in electrical conductivity. The electrical current associated with corrosive action causes the metallic area with the more anodic solution potential to dissolve, forming a pit in the metal surface. The depth of pitting depends on the amount of current that flows from anode to cathode, which, in turn, may depend on several factors such as anode-to-cathode area, environment, temperature and pressure. When the mechanism that causes the first pit to form can be determined, a great advance will have been made in understanding the corrosion process.

Galvanic corrosion which occurs on a continuous metallic surface cannot be measured directly. However, the Bureau has developed a method for evaluating this corrosion indirectly, on ferrous surfaces at least. In this method, the currents associated with the changes-in-slope in current-potential curves that occur during cathodic and anodic polarisation are measured, and the values of applied polarising current thus obtained are used to calculate the equivalent corrosion current. This indirect technique has been successfully applied in measuring the corrosion rates of steel in low-resistivity soils and in salt water. A variation of 10 per cent in corrosion rate can be detected in this way.

Now under investigation are the polarising characteristics of iron specimens alloyed with chromium in various amounts up to 20 per cent, together with a similar series that contains, in addition, 3·5 per cent of silicon. Efforts will be made to use the indirect polarisation technique to evaluate other factors affecting corrosion rates. Such factors include temperature, aeration and motion of the electrolyte, heat-treatment and alloying constituents of the basis metal.

One galvanic corrosion study deals with criteria for the cathodic protection of metals, principally ferrous metals. Although cathodic protection is based on well-founded scientific principles, its application has been the subject of considerable discussion. Insufficient negative potential gives inadequate protection, yet maintaining a greater potential than is required is unnecessarily costly. In investigating the problem, the Bureau has made a series of electrical measurements to evaluate the criteria of cathodic protection. In a part of this work it was found that steel exposed to soil environments varying in pH between 2·9 and 9·6 can be protected from corrosion by maintaining the steel at an electrical potential of −0·77V relative to a saturated calomel reference cell. Recent laboratory experiments showed that −0·77V is also the optimum potential for protecting steel in salt water.

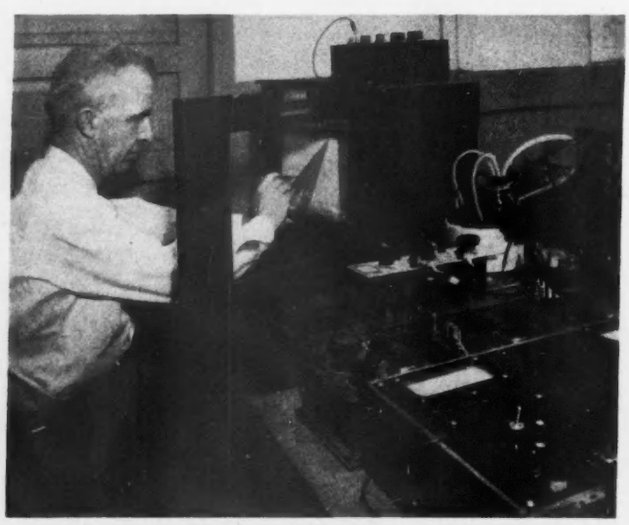


Fig. 5—Instantaneous rate of corrosion of an iron specimen immersed in salt water being obtained from the polarisation curve on a pen recorder

Stress Corrosion

The crystal structure of metals has a direct bearing on stress-corrosion cracking, which is a particularly damaging type of failure resulting from the combined effects of stress and corrosion. Cracking may be either intercrystalline, as in aluminium alloys and low-carbon steels, or

transcrystalline, as in magnesium alloys and stainless steels. Of particular interest are the copper-zinc alloys, in which the attack is intercrystalline in the alpha phase and transcrystalline in the beta phase. Residual or applied tensile stresses—frequently far below the yield strength of the material—may produce this type of failure even though the corrosive effect itself is very mild. Specific environments are often required,

Fig. 6—Mechanical test rig set up for determining part played by hydrogen in stress-corrosion cracking

but in some cases a number of different media may cause cracking. Most investigators agree that practically all metals and alloys are subject to this failure when the necessary combination of stress and corrosion is present.

When most metals are exposed to ordinary atmospheres, a thin oxide covering quickly forms that tends to protect the metal from further corrosion. Stress-corrosion cracking apparently starts with a scratch or break in the protecting film. In investigating this type of cracking in several metals, the Bureau found that the process usually is continuous to complete failure. However, if shifts in stress concentrations permit the repair of the film from time to time, the process may be discontinuous.

For years stress-corrosion cracking has been a problem in the production of wrought brass articles. During spinning and deep drawing, stresses are set up which remain in the metal unless removed by annealing. In studying this problem, the relationship between crystallographic orientation and cracking of both alpha and beta brasses was investigated. Experimental results showed that the intercrystalline cracking in alpha brass apparently depends on the relative orientation of the crystals bordering the cracks and, hence, on the crystal boundary energy. In beta brass, transcrystalline cracking occurs in crystals oriented most favourably for slip and in planes that are approximately normal to the applied stress.

Experiments conducted for the Corrosion Research Council with a magnesium alloy indicated that the development of cracking is dependent upon strain rate. However, these studies present very strong evidence that stress corrosion is partly an electrochemical phenomenon and not one of mechanical fracture only. Recent work on austenitic stainless steels for the Pressure Vessel Research Committee disclosed that sporadic but repeated creep in favourably oriented areas may rupture the protective film. This rupture provides a small film-free anodic area where stress corrosion can begin. By making the stressed steel become the anode in an external circuit, the corrosion can be accelerated. On the other hand, the corrosion can be prevented or stopped by the application of a cathodic current.

Current stress corrosion studies include the exposure of specimens, principally aircraft alloys, to an urban atmosphere at Washington, D.C., and to a marine atmosphere on the Atlantic Ocean at Kure Beach, North Carolina. These studies are quite limited, however, in comparison with the main effort which is directed toward developing fundamental data on the complex corrosive process.

Future Programme

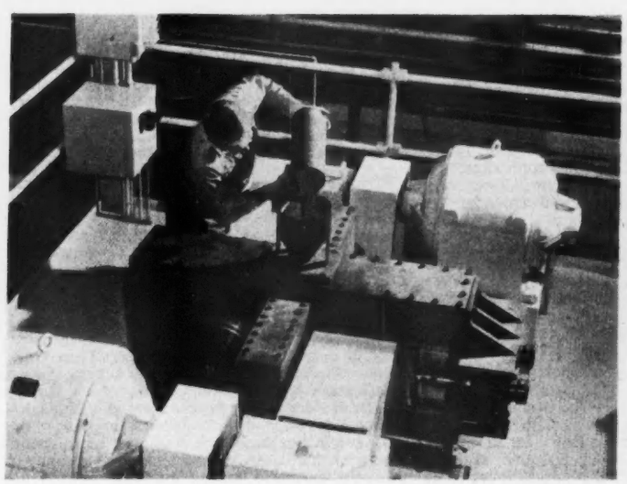
In the near future, the Bureau expects to investigate corrosion inhibitors of the precipitate or barrier type. This work will explore the kinetics and energy associated with the formation of the precipitate, and the forces binding it to a metal surface. Additional corrodents will be studied in the work on aluminium single crystals, and single-crystal research will be extended to other high-purity metals. A specimen in which most of the variables can be controlled has been devised for future stress corrosion studies. Investigations have been started on the influence of temperature and high pressures on the mechanism and kinetics of metal oxidation, as well as additional work on the reactions between atomic oxygen and metallic surfaces. The results of these and related studies are expected to provide science and industry with solutions to some of the practical corrosion problems that are causing concern to-day.

Direct Production of Strip Steel from Iron Ore

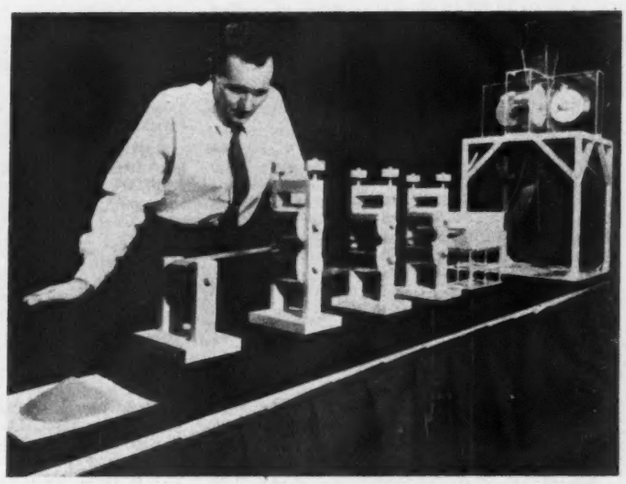
The Republic Steel Corporation, of Cleveland, Ohio, announced recently that it is successfully producing strip steel from iron ore, without melting, at the company's new research centre, in Independence, Ohio. The new technique involves a strip steel rolling process which uses iron powder and by-passes such normal production operations as coke ovens, blast-furnaces, open hearths and blooming mills. The work on the process up to this time has been confined to the laboratory phase. The next stage will be to move to a continuous pilot plant line where larger quantities of materials can be handled. The new process has the potential to reduce capital equipment and production costs while producing steel equal in quality to the steel made by conventional methods. Republic has made steel in the laboratory which offers the same strength, ductility and ability to be fabricated into finished parts as steel produced by other methods. The firm's announcement is believed to be the first official statement by a steel company concerning the production of strip steel directly from iron ore.

As illustrated here, the Republic process consists of three major steps. In the first instance, iron ore is highly purified and reduced to metallic iron powder. Secondly, it is funnelled between four rolls where it is compressed from a powder into a semi-solid strip by rolling. Finally, the semi-solid strip which emerges from the second step passes through a furnace where it is heated to 2200 deg. Fah. in a reducing atmosphere and passes on through a series of hot strip rolling stands. This hot rolling step reduces the thickness of the steel strip to the desired gauge and to full density and produces hot rolled steel in coils. The hot rolled coils have the same quality as conventionally made steels. After the hot rolling and coiling operation, the steel then goes through the usual operations of pickling, cold rolling and annealing before being recoiled or cut into sheets. Republic has produced more than 1800 lb of steel by the new process in the laboratory and tests to date clearly show that one can produce a steel of quality by this method.

Powder metallurgy and direct reduction in recent years have been receiving increasing attention from the American steel industry. Republic, in addition to other companies, has long been interested in this specialised field. The company was among the first to build and operate a direct reduction plant in this country. This facility was constructed during World War II at Warren, Ohio. The direct reduction unit produced electric furnace scrap directly from iron ore by the use of coke oven gas. Somewhat later, at a pilot plant in Cleveland, Republic experimented with a process for beneficiating low-grade iron ores by using a combination of chemical purification and direct reduction.



Feeding of reduced metallic iron powder into compacting mill, comprising two main rolls and two edging rolls



Model illustrating the operating sequence of direct strip steel production, with compacting mill, heating furnace, three mill stands and coiler

Personal and Business

Appointments

MR. F. J. JERVIS has been appointed contracts manager of Nash and Thompson, Ltd.

MR. G. E. DIX has been appointed purchasing manager of Massey-Ferguson Tractors, Ltd.

MR. MATTHEW REID MOORE has been appointed manager of the mining and general products division of Richard Sutcliffe, Ltd.

MR. F. G. T. HOWARD has joined the staff of British Central Electrical Company, Ltd., as personal assistant to the managing director.

DR. PETER JOHN GRANT has been appointed to the readership in engineering science at the Imperial College of Science and Technology.

MR. DUDLEY V. DOLAN has been appointed sales representative for H. Leverton and Co., Ltd., covering Lincolnshire, Nottinghamshire and Leicestershire.

THE CENTRAL ELECTRICITY GENERATING BOARD has announced the appointment of Mr. J. H. Butler to the post of generation engineer to the north-eastern division.

EAGRE CONSTRUCTION COMPANY, Ltd., announces that Mr. Thomas Twomey, general manager, Mr. John P. P. Spafford and Mr. David M. H. Spafford have been appointed directors.

MR. L. R. MORTIMER has been appointed to represent Kelvin and Hughes (Industrial), Ltd., in the south-eastern counties in succession to Mr. A. R. Mewitt who has been appointed assistant technical sales manager.

THE BRITISH SHIPBUILDING RESEARCH ASSOCIATION announces that Sir James Milne has been elected chairman of the council in succession to Sir James McNeill. Colonel T. Eustace Smith has been elected vice-chairman of the council in succession to Sir James Milne. These appointments are for the next two years.

CARBIDE INDUSTRIES, Ltd., has announced the appointment at its carbide and acetylene factory at Maydown, near Londonderry, of Dr. T. W. T. Baillie as production manager, Mr. W. W. Ringland as chief works engineer, Mr. A. R. Robertson as commercial manager and Dr. R. D. Thrower as works research and development manager.

THE BOARD OF TRADE announces that Mr. Peter B. Inchbald has been appointed a member of the Council of Industrial Design. Dr. F. Llewellyn Smith, M.I.Mech.E., and Mr. I. W. Macdonald have been appointed part-time members of the National Research Development Corporation, in succession to Sir John Duncason and Sir Rowland Smith.

THE YALE AND TOWNE MANUFACTURING COMPANY, BRITISH MATERIALS HANDLING DIVISION, has announced the appointment of Mr. John McIvor as Scottish area sales manager and Mr. G. K. Frame as Scottish area sales engineer. They will operate from Yale and Towne's new sales and service depot at East Kilbride, Lanarkshire (telephone East Kilbride 20241).

GEORGE ELLISON, Ltd., announces the appointment of Mr. D. L. Stokes as technical sales engineer for Ellison products in the counties of Essex, Norfolk, Suffolk, Huntingdon, Cambridge and Isle of Ely. The south-east area sales and consultative service have been re-allocated as follows: Mr. F. W. Webb, Middlesex, Bedfordshire and Hertfordshire; Mr. H. V. Stanton, Surrey, Sussex, Kent, and Mr. P. C. Stewart, Oxford, Bucks, Hants, Berkshire and Isle of Wight.

Business Announcements

MR. CHARLES SOUKUP, managing director of Richard Klinger, Ltd., has retired owing to ill-health.

THE AMERICAN SOCIETY FOR METALS has moved to Metals Park, Novelty, Ohio (telephone Jordan 4-2271).

MR. MICHAEL BOBY, managing director of William Boby and Co., Ltd., Rickmansworth, Herts, has left on a world sales-research trip.

COPPERAD, Ltd., Colnbrook, Bucks, states that it has acquired the entire share capital of the Marwood Miller Group of Companies.

MR. S. R. HOWES has retired from the board of the United Steel Companies, Ltd. He remains managing director of Templeborough Rolling Mills, Ltd.

MR. R. A. BENT, managing director, and MR. R. J. F. HOWARD, director, of Lancashire Dynamo Electronic Products, Ltd., are making an overseas tour.

REINFORCED PLASTIC DEVELOPMENTS announces that it has taken over new premises at Old Town Wharf, Swan Street, Isleworth, Middlesex (telephone Isleworth 6319).

MR. JOHN E. COLEMAN, M.I.E.E., has relinquished his directorship and major share-holdings in Spesco Developments, Ltd., which will in future be controlled by Imperial Chemical Industries, Ltd.

EVERSHED AND VIGNOLES, Ltd., Chiswick, London, W.4, has announced the reorganisation and enlargement of its Canadian activities by the formation of a new company, Evershed-Powertronic, Ltd.

MARTONAIR, Ltd., Parkshot, Richmond, Surrey, announces that it has formed a French company, Martonair S.A.R.L., under the management of Mr. Gerald Simon. The address of the company is 41 bis. Bld. Paul Vaillant-Couturier, Montreuil (Seine) (telephone, Avron 49–26).

KEELAVITE HYDRAULICS, Ltd., Allesley, Coventry, has appointed Holman Brothers (Pty.), Ltd., P.O. Box 6218, Johannesburg, as its agent for the sale of hydraulic equipment in South Africa and Rhodesia. Holman Brothers are manufacturing hydraulic cylinders under licence from Keelavite.

SHARPLES CENTRIFUGES, Ltd., announces that it has recently purchased the German Company, Gesellschaft für Trenn-und Trockentechnik m.b.H., manufacturers of the "Contessor" conical screen centrifuge. It has also purchased the centrifugal division of the Fletcher Works Incorporated, U.S.A. This will in future be known as the Fletcher division of Sharples.

COATING CONTRACTORS, Ltd., Buckingham, was formed in July as a wholly-owned subsidiary of E. and F. Richardson, Ltd., Buckingham, manufacturer of "Adcora" coating compounds. The firm announces that it is ready to undertake work at the factory or on the site in connection with elastomeric, hard, and chlorinated coatings, especially substances requiring complex additives, and "high-built" coatings applied by airless methods. The materials include, among others, "Neoprene," "Hypalon," and "Viton," the last being capable of resisting temperatures up to 500 deg. Fah. Coatings can be applied to pipes down to 2in diameter, vessels, plant and structures to prevent corrosion, erosion and abrasion. The company does not undertake ordinary painting contracts.

THE GENERAL ELECTRIC COMPANY, Ltd., states that, following discussions which have taken place during the last few weeks between The General Electric Company, Ltd./Simon-Carves, Ltd., Atomic Energy Group and Atomic Power Constructions, Ltd., an agreement has been reached to collaborate in the design and construction of nuclear power stations in the United Kingdom. The two groups have agreed to submit joint tenders for Dungeness and further stations in the British nuclear programme. This development does not affect the two groups' existing contracts and commitments, either in the United Kingdom or Overseas. The Central Electricity Generating Board and the South of Scotland Electricity Board have been informed. Negotiations are continuing with a view to long-term collaboration on future reactor systems.

Contracts

WOODFIELD ROCHESTER, Ltd., has received from Yugoslavia a contract, valued at over £750,000, for oilfield drilling and production equipment.

SOUTH DURHAM STEEL AND IRON COMPANY, Ltd., has received a contract, worth approximately 1,500,000 dollars, for the supply of steel pipe and sheet piling to British Columbia for the foundation work of the Port Mann bridge.

HAWKER SIDDELEY BRUSH INTERNATIONAL, Ltd., has received an order, worth over £500,000, from the N.A.T.O. Authorities in Turkey, for the supply of forty-four diesel generating sets, totalling 10,000kW. The diesel engines will be manufactured by Mirrlees, Bickerton and Day, Ltd., and the electrical equipment by Brush Electrical Engineering Company, Ltd.

JOHN PICKLES AND SON (ENGINEERS), Ltd., has secured, through the agency of The Colombo Commercial Company, Ltd., a contract to supply to Ceylon three complete electrically-driven sawmills, each having a 60in vertical log bandmill, a 54in vertical band resaw, a multi-saw edger, roller feed and hand feed sawbenches, crosscuts and planers, and three saw sharpening and cutter grinding equipments.

HUMPHREYS AND GLASGOW, Ltd., has received a contract for the supply, erection and commissioning of gas-making plant in Bhopal, India. This contract was awarded through Associated Electrical Industries, Ltd., acting as purchasing agents for Heavy Electricals, Ltd., which is constructing a factory for the manufacture of heavy electrical machinery in Bhopal. The contract is for a complete small gas works to supply blue water gas made from coke for use throughout the factory. The volume of gas produced will be about 1,500,000 cubic feet per day.

RICHARD COSTAIN, Ltd., has been awarded a contract by the Ministry of Transport and Civil Aviation, valued at £240,000, to extend the main runway at Prestwick Airport. Work is scheduled to begin at the end of September, and the contract should be completed by June, 1960. The contract provides for the construction of 2300ft of reinforced concrete runway and perimeter tracks at the seaward end of the existing runway, to give a total length of 9800ft: 250,000 cubic yards of imported filling will be required to give the new levels and a large storm-water drainage scheme will also be constructed.

JOHN THOMPSON (PIPEWORK) COMPANY, of Wolverhampton, has received an order for £490,000 to supply the high pressure pipework and valves for turbine sets numbers 5 and 6 at Blyth "B" power station. The conditions at the 275MW turbine stop valves are 2300 lb per square inch gauge at 1050 deg. Fah., and the main steam pipework will be designed for a pressure of 2500 lb per square inch gauge at a temperature of 1055 deg. Fah. Design pressure for the feed pipework will be 3900 lb per square inch gauge. The order includes main steam lines (9in bore), reheater inlet and outlet lines (20in) and 10in bore main feed lines for each of the two sets, together with blowdown and high pressure drain pipework and valves. Chrome-molybdenum-vanadium tubing, to be used for the main steam and the reheater outlet lines, will involve special welding techniques.

METROPOLITAN-VICKERS SOUTH AFRICA (Pty.), Ltd., has received an order from the Electricity Supply Commission of South Africa for two 100MVA auto-transformers for Komati power station. The transformers will be made by the A.E.I. transformer division. They will have graded insulation windings for a voltage ratio at no-load of 275/132kV and will incorporate 22kV delta-connected, fully insulated tertiary windings for a 20MVA load. One h.v. winding of one transformer will be subjected to an impulse test of over a million volts. The 275kV terminals will emerge through condenser bushings. Type "H" on-load tap changers will constitute the 132kV terminals, and will be used for a tapping range of 15 per cent of 275kV. They will be suitable both for local electrical and automatic control, with provision for parallel control of the two transformers, and will be of the type of which a large number are now in service on the British grid and super-grid. Oil cooling with natural oil circulation will be employed for output up to 50MVA. Oil circulating pumps and air-blast fans will enable higher outputs up to full load to be obtained, the pumps and fans being automatically controlled by a winding temperature indicator.

Miscellanea

MR. D. S. GARDNER.—We record with regret the death of Mr. Douglas S. Gardner, which occurred suddenly at Kilmarnock on September 20. Mr. Gardner, who was forty-one, was a director and the works manager of Glenfield and Kennedy, Ltd. He entered the company's service in 1933.

THIRD INTERNATIONAL CONFERENCE ON MEDICAL ELECTRONICS, JULY, 1960.—The Institution of Electrical Engineers is organising the Third International Conference on Medical Electronics in London in the second half of July, 1960, in association with the International Federation for Medical Electronics which was inaugurated this year. The object of the conference is to bring together members of the medical and electrical engineering professions in discussion, so that each will gain a better understanding of the problems of the other. Accordingly, there will be general sessions to enable medical practitioners and electrical engineers who are not experts in medical electronics to increase their background knowledge, and specialist sessions in which those engaged in medical electronic work can present papers on the latest developments and discuss particular problems in greater technical detail. It is proposed to organise an international scientific exhibition on medical electronics in conjunction with the conference.

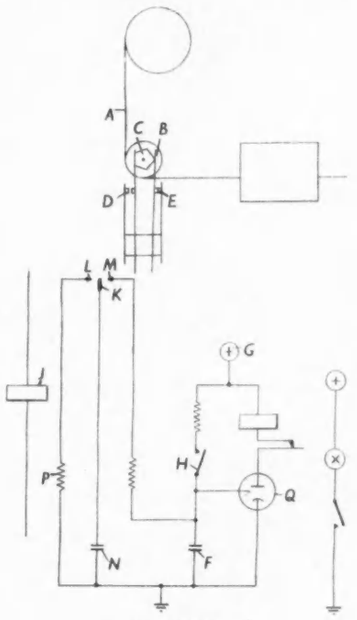
British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings, unless otherwise stated. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

TELECOMMUNICATIONS

815,964. December 12, 1957.—TAPE FEEDING APPARATUS, Creed and Co., Ltd., Telegraph House, Croydon, Surrey. (*Inventor: Anthony Walter Wallens.*)

According to the present invention the tape being fed to a reperforator operates the contacts of a capacitor-charging system, and a failure in feed causes a charged capacitor to set a warning circuit in operation. Referring to the upper drawing, the tape *A*

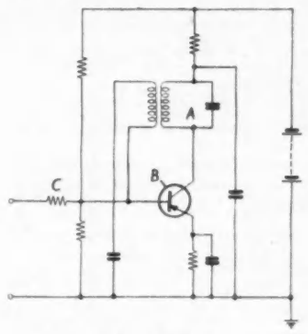


No. 815,964

causes roller *B* to be rotated whenever it is feeding. Cam *C* is arranged to control two sets of electrical contacts *D* and *E*, so that they are alternately opened and closed, but can never be closed together. In the lower drawing, a capacitor *F* is charged from potential source *G* through a contact *H* of relay *J*, which is energised when the reperforator is operating. The moving parts of the sets of contacts *D* and *E* are connected together electrically and are denoted by the one contact point *K*. The fixed parts are denoted by the contact points *L* and *M* respectively. When the tape is feeding through the reperforator, the effect is of contact point *K* moving to and fro and making contact alternately with contact points *L* and *M*. Capacitor *F* is charged at such a rate that the charging time is greater than the time of successive contacts between *K* and *M*. When these contacts are made, the charge on *F* is shared with capacitor *N*. When *K* makes contact with *L*, capacitor *N* is discharged through resistance *P*. If the tape feed stops, contact *K* is arrested and according to its position either capacitor *F* alone or capacitors *F* and *N* together are charged to a sufficient potential to trigger gas-filled tube *Q* and actuate the warning circuit.—*July* 1, 1959.

815,911. December 12, 1956.—OSCILLATOR CIRCUITS INCORPORATING JUNCTION TRANSISTORS, The General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2, and Alan Seymour Robinson, of The General Electric Company, Ltd., Telephone Works, Coventry.

It is an object of the present invention to provide an oscillator circuit incorporating a junction transistor which can be readily arranged to operate at varying frequencies. One arrangement is shown in the accompanying drawing, which is a diagram of an oscillator circuit incorporating a junction transistor for use in a frequency shift telegraphy signalling system. The total capaictance included in the resonant circuit *A* includes a multiple of the so-called collector capacitance of the transistor *B*, the magnitude of this multiple depending upon the base-to-collector current gain factor of the transistor; thus, any variation in this collector capacitance will produce a corresponding change in the frequency of the oscillations generated. In frequency shift telegraphy "space" and "mark" signal elements are transmitted at different frequencies, and in the present arrangement this is effected by applying a modulating signal to the oscillator between earth and one end of resistor *C*. The modulating signal is of rectangular waveform so that upon its application to the circuit the mean collector current flowing in the circuit has one value during a "space" signal element and a

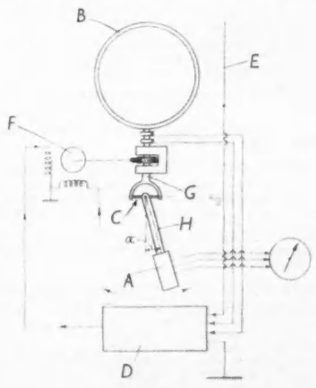


No. 815,911

different value during a "mark" signal element; thus the mean voltage appearing between the collector and base electrodes of the transistor is different during "space" and "mark" signal elements. Variation of the mean voltage between the base and collector electrodes of a junction transistor results in inverse variation of the collector capacitance. Thus, the application of the modulating signal will result in different values of the total capacitance included in the resonant circuit *A*, and, hence, in different oscillation frequencies, during "space" and "mark" signal elements. The extent of the shift in frequency depends upon the amplitude of the modulating signal, and it is effected without physically altering the magnitude of any of the oscillator components.—*July* 1, 1959.

815,656. June 5, 1956.—RADIO COMPASSES, Air-Equipment, 18, rue Basly, Asnières (Seine), France.

It is known that owing to the earth formed by the body of an aircraft carrying a radio compass, the aerial or frame of the radio compass does not always indicate exactly the direction of the transmitter or radio station the signals from which are to be picked



No. 815,656

up. This direction is subjected to an error known as "quadrantal error," and is of the form

$$\tan \phi = K \tan \phi^1,$$

wherein ϕ is the true bearing angle, ϕ^1 is the apparent bearing angle, and *K* is a constant depending on the aircraft carrying the radio compass. The invention is based on the fact that a single cardan joint satisfies the law $\tan x = \cos \alpha \tan y$, in which *x* is the angle of rotation effected by one of the shafts of the joint, *y* is the angle of rotation effected by the other shaft of the joint, and α is the angle between these two shafts. In a radio compass according to the invention, with an indicator remotely controlled by a tele-indicating device, the tele-indicating transmitter (*A* in drawing) has movable or control means connected to the rotatable loop aerial *B* by means of a single cardan joint *C*. With further reference to the drawing, the turns of wire of the loop aerial are connected to two sliprings against which are applied current-receiving brushes connected to an electronic apparatus *D*. An antenna *E* which serves to remove doubt in the readings (error of 180 deg.) is also connected to *D*. The loop aerial is driven by the motor *F* so as to be constantly in the apparent direction of the radio station. The correcting arrangement between loop shaft *G* and tele-transmitter *A* is the single cardan joint *C* referred to already, and to correct quadrantal error it is merely necessary to vary angle α between loop shaft *G* and drive shaft *H* of the transmitter until $\cos \alpha$ has the value *K* in the expression $\tan \phi = K \tan \phi^1$, whereupon the error disappears. In a mobile object having an axis of symmetry, such as an aircraft, the angle α is situated in the plane of symmetry of the aircraft. Locking means, not shown in the drawing, permit, after determining the angle α, locking the unit *A* in the required angular position.—*July* 1, 1959.

MACHINE TOOLS

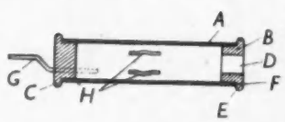
816,519. October 11, 1957.—LATHES, General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2. (*Inventor: George Percival Hewlett.*)

According to the invention, the catch plate for a centre lathe has its face recessed to receive and shroud the central carrier attached to work. This shrouding of the carrier eliminates danger of the arms catching a machine operator's hands or clothing.—*July* 15, 1959.

ELECTRIC LIGHTING

816,054. December 22, 1955.—ELECTRIC DISCHARGE DEVICES CONTAINING COLD HOLLOW ELECTRODES, Claude Paz et Visseaux, formerly known as Société Anonyme Pour Les Applications de L'Electricite et des Gaz Rares—Etablissements Claude-Paz and Silva, 8 rue Cognacq-Jay, Paris, France.

This invention relates to electric discharge devices containing gas and mercury vapour and comprising at least one cold and hollow electrode to the inner wall of which has been fixed at least one small piece comprising, mainly or solely, one or more rare earth metals in a metallic condition, for instance, lanthanum and/or cerium. Cold electrodes generally consist of a hollow metal cylinder which is open at one end and secured to one or more current lead-in wires, the edge of the aperture at the open end being, generally, provided with an insulating piece which protects the edge from ionic bombardment and prevents the electrode from touching the wall of the discharge tube. These electrodes have long lives but they cause an important voltage drop. This may be decreased by providing the inner wall of the electrode with an electron-emitting coating. One object of the invention is to provide an electron discharge device having electrodes the voltage drop of which is substantially smaller than that of cold electrodes, non-activated, this voltage drop remaining low for a very long duration. The drawing



No. 816,054

shows, in longitudinal section, the electrode before it is mounted inside the envelope of the discharge device. It comprises a cylinder *A* made of sheet metal, for instance nickel plated iron sheet, at the ends of which are two steatite parts *B*, *C*. The part *B* is provided with an orifice *D* allowing the electric discharge access to the inside of the electrode. The part *B* is also formed with a flange *E* which prevents the discharge from occurring on the edge *F* of the cylinder *A* and from causing a heavy sputtering of the sheet metal at that place. The other steatite part *C* closes the end of the cylinder opposite that through which the discharge passes and this closure need not be airtight. A wire *G*, welded to the cylinder, supports the electrode and supplies it with electric current. Some pieces *H* of rare earth metal or of an alloy of rare earth metals, are secured on the inner wall of the cylinder. In the embodiment illustrated the two pieces comprise segments of lanthanum wire, welded at their mid points to the cylinder. With the electrodes as described, it is not necessary to perform de-gassing by heating so strongly as usual, and a mere oven heating, with no discharge or high frequency may be sufficient. The residual pressure, at the time when the pumping is stopped, does not have to be as low as when usual cold electrodes are used, since the rare earth metal pieces will absorb the small amount of non-rare gases which has not been eliminated by the de-gassing. Another advantage of these electrodes, due probably to the absorption of the detrimental gases by the pieces *H* is the decrease in the voltage drop through the discharge column. The discharge, substantially,

does not occur on the outer surface of the electrode because of the presence of electron-emissive material inside. This stabilises the cathode glow and decreases considerably the cathode sputtering at the outside of the electrode. This makes it often possible to simplify the constitution of the electrode by omitting the insulating parts such as those shown at *B* and *C*, and by not surrounding the electrode with a sheet of mica, a sheet often used for improving the insulation between the electrode and the glass of the discharge tube. This decreased sputtering increases the life of the electrode.—*July* 8, 1959.

ELECTRICAL ENGINEERING

813,582. April 20, 1956.—VOLTAGE REGULATORS, Sorensen and Company Incorporated, 375, Fairfield Avenue, Stamford, Connecticut, United States of America.

This invention relates to voltage regulators for alternating current supply lines which are rectified to produce a regulated direct current voltage. It employs two transformer cores, each of these cores being normally operated at a value of magnetic flux which partially saturates the core material. The value of the output voltage, above or below a desired value, is sensed by a Wheatstone bridge arrangement containing one or two dry plate rectifiers as the bridge arms. This sensing circuit together with a plurality of biasing and controlling coils on the two transformer cores produces regulation at the load terminals. The absence of electron discharge devices eliminates failure due to broken filaments, short-circuited elements within a vacuum container and loss of vacuum.—*May* 21, 1959.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

To-day, Oct. 2.—LIVERPOOL AND DISTRICT BRANCH: Industrial Development Centre, M.A.N.W.E.B, Paradise Street, Liverpool, 1, "The National Inspection Council—Its Aims and Objects," E. J. Sutton, 7.30 p.m.

Mon., Oct. 5.—ESSEX BRANCH: Angel Hotel, Ilford, "Modern Lift Controllers and Systems," C. F. Scholefield, 8 p.m. ★ LEEDS BRANCH: Great Northern Hotel, Leeds, "Switchgear," R. G. Camp, 7.30 p.m. ★ SHEFFIELD BRANCH: Royal Victoria Hotel, Sheffield, "Kopp Variators," N. S. Sellers, 7.30 p.m.

Tues., Oct. 6.—READING AND DISTRICTS BRANCH: "Marquis of Lorne," Friar Street, Reading, "Electricity in Agriculture," D. Holley, 7.30 p.m. ★ WEST KENT BRANCH: Rose and Crown Hotel, Tonbridge, "How Radio and Television Affect the Supply Authorities," C. F. Hollingworth, 7.30 p.m.

Wed., Oct. 7.—HALIFAX BRANCH: Crown Hotel, Horton Street, Halifax, Open Branch Meeting, 7.45 p.m. ★ MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "Control Centres for Modern Industry," R. G. Camp, 7.15 p.m. ★ NORTH LONDON BRANCH: Wood Green Civic Centre, Town Hall, Wood Green, London, N.22, "Silicones," K. J. Brimley, 8 p.m. ★ PRESTON BRANCH: R.A.F.A. Club, East View, Preston, "The Installation of Electric Lifts," J. McEnery, 7.30 p.m. ★ WEST LONDON BRANCH: Windsor Castle Hotel, 134, King Street, London, W.6, "Signalling and Control Systems as Used by London Transport," G. R. Kent, 7.30 p.m.

Thurs., Oct. 8.—BRADFORD AND DISTRICT BRANCH: Midland Hotel, Bradford, "Industrial Landscape or Scenery and History," E. M. Sigsworth, 7.30 p.m. ★ SOUTH WEST LONDON BRANCH: Prince of Wales Hotel, London, S.W.19, "The National Inspection Council and Its Effect on the Contracting Industry," E. J. Sutton, 7.45 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

To-day, Oct. 2.—S. MIDLANDS SECTION: North Gloucestershire Technical College, "Loudspeakers," F. H. Brittain, 7 p.m.

Wed., Oct. 7.—COMPUTER GROUP: London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1, "Some Reflections on Computer Design," W. Renwick, 6.30 p.m. ★ S.W. SECTION: School of Management Studies, Unity Street, Bristol, Annual General Meeting, 6 p.m. Chairman's Address, "The Drift of Electronics," L. Hix, 6.30 p.m. ★ S.W. SECTION: R.A.F. Radio Apprentices School, Locking, near Weston-super-Mare, Symposium on "The Training of Radio Apprentices," 10.30 a.m.–4.30 p.m.

COMBUSTION ENGINEERING ASSOCIATION

Wed., Oct. 7.—SCOTTISH REGION: Grand Hotel, Charing Cross, Glasgow, Brains Trust on "Clean Air and Industry," 10 a.m. A discussion on "Instrumentation and Smoke Control," opened by P. J. Turner, 2 p.m.

Tues., Oct. 13.—NORTHERN REGION: Grand Hotel, Sheffield, "A Brains Trust on Furnace Operation," 10.30 a.m.

INSTITUTE OF MARINE ENGINEERS

Mon., Oct. 5.—STUDENT LECTURE: The Memorial Building, 76, Mark Lane, London, E.C.3, "Watchkeeping and Maintenance in a Motor Ship," S. Speed, 6.30 p.m. ★ MERSEYSIDE AND N.W. SECTION: Liverpool Engineering Society, The Temple, Dale Street, Liverpool, "Marine A.C. Distribution Equipment with particular reference to H.R.C. Fuses," M. J. Bolton, 6 p.m.

Tues., Oct. 6.—The Memorial Building, 76, Mark Lane, London, E.C.3, Presidential Address, Sir William Wallace, 5.30 p.m.

Thurs., Oct. 8.—JUNIOR LECTURE: Poplar Technical College, London, E.14, "The Lay-Out and Operation of Marine Steam Turbine Machinery," D. M. V. Parkinson, 6.30 p.m.

Tues., Oct. 13.—Memorial Building, 76, Mark Lane, London, E.C.3, "Centrifugal Purification of Oils," M. E. O'K. Trowbridge, 5.30 p.m.

INSTITUTE OF PETROLEUM

Wed., Oct. 7.—61, New Cavendish Street, London, W.1, "Piston Ring Friction: Rig Measurements with Low Viscosity Oils," A. de Faro Barros and A. Dyson, 5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Mon., Oct. 5.—SCOTTISH CENTRE: Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow, "The Development and Application of the 4-99 Diesel Engine," H. L. Parish, 7.30 p.m. ★ EAST REGIONAL CENTRE: Council Chamber, Houldsworth Hall, 90, Deansgate, Manchester, Films, "Wheels Round the World" and "Off the Beaten Track," 7.30 p.m.

Tues., Oct. 6.—WESTERN CENTRE: Royal Hotel, Bristol, Engineers' Forum, 6.30 p.m. ★ EASTERN CENTRE: Swan Hotel, Bedford, "A Review for the Selection, Specification and Design of a Commercial Vehicle," E. B. H. Elsbury, 7 p.m.

Wed., Oct. 7.—EAST MIDLANDS CENTRE: Mechanics' Institute, Nottingham, "Transport Developments in U.S.A.—1957," John F. Moon, 7.30 p.m.

Fri., Oct. 9.—SOUTH WALES CENTRE: South Wales Institute of Engineers, Park Place, Cardiff, "Oil Additives," A. Towle, 7.15 p.m.

Mon., Oct. 12.—WEST REGIONAL CENTRE: Liverpool Architectural Society's Rooms, Bluecoat Chambers, School Lane, Liverpool, 1, "The Design of Radial-Flow Turbochargers and their Application to Road Transport," E. Kellett, 7.30 p.m.

INSTITUTION OF CHEMICAL ENGINEERS

Tues., Oct. 6.—Geological Society, Burlington House, Piccadilly, London, W.1, "The Controlled Crystallisation of Sodium Chloride," J. Bain and F. Rumford, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon., Oct. 5.—S. MIDLAND CENTRE: Grand Hotel, Birmingham, Annual General Meeting, Chairman's Address, G. F. Peirson, Conversazione. ★ EAST ANGLIAN SUB-CENTRE: Electric House, Ipswich, Chairman's Address, "Railway Electrification in Great Britain," D. H. McCracken, 6.30 p.m. ★ MERSEY AND N. WALES CENTRE: Royal Institution, Colquitt Street, Liverpool, "The Development of the Telephone System in Great Britain," T. A. P. Colledge, 6.30 p.m. ★ MAIDSTONE DISTRICT MEETING: Technical College, Maidstone, "The National Inspection Council—Two Years' Operation," E. J. Sutton, 6.30 p.m.

Tues., Oct. 6.—EAST MIDLAND CENTRE: College of Further Education, Loughborough, Chairman's Address and Annual General Meeting, D. H. Parry, 6.30 p.m. ★ NORTH MIDLAND CENTRE: Leeds and County Conservative Club, South Parade, Leeds, 1, Chairman's Address, "Electrical Engineering at Redbrick University," G. W. Carter, 6.30 p.m. ★ NORTH-WESTERN CENTRE: Engineers' Club, 17, Albert Square, Manchester, Chairman's Address, F. J. Hutchinson, 6.30 p.m. ★ S.E. SCOTLAND SUB-CENTRE: Carlton Hotel, North Bridge, Edinburgh, Chairman's Address, J. A. Aked, 7 p.m.

Wed., Oct. 7.—TEES-SIDE SUB-CENTRE: Cleveland Scientific and Technical Institution, Middlesbrough, Chairman's Address, M. A. Raisbeck, 6.30 p.m. ★ NORTH-WESTERN ELECTRONICS AND COMMUNICATIONS GROUP: Engineers' Club, Albert Square, Manchester, Chairman's Address, "Some Features of the Post Office Telephone and Television Networks in the North-West," S. D. Mellor, 6.15 p.m. ★ S.W. SCOTLAND SUB-CENTRE: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, Centre Chairman's Address, J. A. Aked, 6 p.m. ★ SOUTHERN CENTRE: C.E.G.B. Offices, Portsmouth, Chairman's Address, W. D. Mallinson, 6.30 p.m. ★ OXFORD DISTRICT MEETING: Southern Electricity Board Service Centre: 37, George Street, Oxford, "New Methods of Exploiting Electronic Computers in the Industry," H. McG. Ross, 7 p.m.

Thurs., Oct. 8.—WEST WALES (SWANSEA) SUB-CENTRE: Conference Room, S.W.E.B. Showrooms, The Kingsway, Swansea, Chairman's Address, J. Harley, 6 p.m.

Fri., Oct. 9.—NORTH STAFFORDSHIRE SUB-CENTRE: Duncan Hall, Stone, Chairman's Address, "The Use of Information in Control Systems," A. Asbury, 7 p.m. Ordinary Meeting: Savoy Place, London, W.C.2, President's Inaugural Address, Sir Willis Jackson, 5.30 p.m.

INSTITUTION OF ENGINEERING DESIGNERS

Wed., Oct. 7.—MIDLAND BRANCH: Queens Hotel, Birmingham, "Titanium and its Alloys for Chemical Plant," B. J. Conolly, 7.30 p.m.

Mon., Oct. 12.—New Lecture Theatre, Rutherford College of Technology, Northumberland Road, Newcastle upon Tyne, 1, "Planning a Modern Power Station," 7.15 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

Tues., Oct. 6.—39, Elmbank Crescent, Glasgow, Presidential Address, J. Brown, 6.30 p.m.

INSTITUTION OF HIGHWAY ENGINEERS

To-day, Oct. 2.—Lecture Hall, Institution of Structural Engineers, 11, Upper Belgrave Street, London, S.W.1, "Motorways—Their Landscaping, Design and Appearance," G. A. Jellicoe, 5.30 p.m.

Fri., Oct. 9.—NORTHERN BRANCH: County Hall, Kendal, "Skidding Resistance and the Polishing of Roadstones," D. J. Maclean, 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

Mon., Oct. 5.—WESTERN BRANCH: Visit to Berkeley Nuclear Power Station, Gloucestershire, 10 a.m.

Tues., Oct. 6.—AUTOMOBILE DIVISION: 1, Birdcage Walk, Westminster, London, S.W.1, Annual Meeting, 6 p.m., Chairman's Address, "Some Problems We Met," L. H. Dawtrey, 6.30 p.m. ★ SOUTHERN GRADUATES' SECTION: Technical College, Brighton, Film Show, 7 p.m.

Wed., Oct. 7.—EAST MIDLANDS BRANCH: College of Technology, Leicester, "The Importance of Biomechanics as a Service to Man," Illustrated by a Discussion of Problems in Metallic Osteosynthesis, J. Zarek, 7.15 p.m. ★ EASTERN GRADUATES' SECTION: Visit to Morgans Brewery Company, Norwich, 7.30 p.m. ★ NORTH WESTERN GRADUATES' SECTION: Merseyside Film Institute Theatre, Blue Coat Chambers, Liverpool, Technical Film Show, 7 p.m. ★ YORKSHIRE GRADUATES' SECTION: Whole-day visit to the Mines, Quarries and Blast-Furnaces of Stewarts and Lloyds, Ltd., Corby, Northants.

Thurs., Oct. 8.—EASTERN BRANCH: Red Lion Hotel, Colchester, "Materials for Astronautic Vehicles," A. J. Murphy, 7.30 p.m. ★ YORKSHIRE BRANCH: The University, Leeds, "Power Transmission," T. Hall, 6.30 p.m. ★ EAST MIDLANDS GRADUATES' SECTION: Technical College, Lincoln, "Economic Design of Light Alloy Castings," D. A. Broadbent, 7.15 p.m. ★ N.W. INDUSTRIAL ADMINISTRATION AND ENGINEERING PRODUCTION GROUP: Engineers' Club, Albert Square, Manchester, 2, "Protective Coatings," 6.45 p.m.

Sat., Oct. 10.—EASTERN GRADUATES' SECTION: Evening Visit to the Observatories, Cambridge.

INSTITUTION OF NAVAL ARCHITECTS

Wed., Oct. 7.—10, Upper Belgrave Street, London, S.W.1, "The Prospect for a Nuclear Powered Dry Cargo Liner," E. C. B. Corlett and E. P. Hawthorn, 4.45 p.m.

INSTITUTION OF PLANT ENGINEERS

Tues., Oct. 6.—EDINBURGH BRANCH: 25, Charlotte Square, Edinburgh, "Changes in Factory Legislation," A. Gow, 7 p.m. ★ LONDON BRANCH: Royal Society of Arts, John Adam Street, Adelphi, Strand, London, W.C.2, "Packaged Boilers," I. F. G. McVicker, 7 p.m. ★ PETERBOROUGH BRANCH: White Lion Hotel, Church Street, Peterborough, "The Diesel Electric on British Railways," C. Morris, 7.30 p.m.

Wed., Oct. 7.—SOUTHERN BRANCH: Polygon Hotel, Southampton, "Town Planning and the Location of Industry," Roland J. Roddis, 7.30 p.m.

Thurs., Oct. 8.—NORTH-EAST BRANCH: Roadway House, Oxford Street, Newcastle upon Tyne, "Recent Developments in Steelmaking Process," S. G. Cope, 7 p.m.

Fri., Oct. 9.—BIRMINGHAM BRANCH: Hotel Leofric, Coventry, Open Forum, 7.30 p.m.

Tues., Oct. 13.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "New Developments in the Paint Industry," A. Walmsley and A. I. Seavall, 7.15 p.m.

Wed., Oct. 14.—DUNDEE BRANCH: Taypark Hotel, West Ferry, Dundee, "Experience of Training Young Engineers for Marine Service," J. P. Bruce, 7.30 p.m. ★ E. MIDLANDS BRANCH: County Hotel, Theatre Square, Nottingham, "Jodrell Bank Radio Telescope," C. N. Kington, 7 p.m. ★ WESTERN BRANCH: Grand Hotel, Broad Street, Bristol, "Acoustics Insulation and its Thermal Properties," 7.15 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

Tues., Oct. 6.—COVENTRY GRADUATE SECTION: Craven Arms, High Street, Coventry, "Concerning Gleason Methods and Machines," 7.15 p.m.

Wed., Oct. 7.—SCOTLAND REGION: Windmill Hotel, Arbroath, "Numerical Control of Machine Tools," Messrs. Brett and Tack, 7.30 p.m. ★ NORTH MIDLANDS REGION: The Reform Club, Victoria Street, Nottingham, "The Use of Plastics for Making Jigs, Tools and Moulds," P. G. Pentz, 7 p.m. ★ LONDON, BRIGHTON GROUP: Old Ship Hotel, Brighton, "Nylon and the Production Engineer," E. M. Elliott, 7 p.m.

Thurs., Oct. 8.—NORTH MIDLANDS REGION: Evening Visit to the Imperial Typewriter Company, Ltd., East Park Road, Leicester, "The Production Control System at the Imperial Typewriter Company," B. S. Pears, 7.15 p.m.

Mon., Oct. 12.—1959 E. W. HANCOCK PAPER: Large Lecture Theatre, Engineering Faculty, The University, Bristol, "Human Relations in Industry," R. A. Banks, 6.30 p.m.

Tues., Oct. 13.—LONDON GRADUATE SECTION: 10, Chesterfield Street, Mayfair, London, W.1, "Properties and Application of Modern Precision Grinding Wheels," J. Manning and R. Barton, 7.15 p.m. ★ LUTON GRADUATE SECTION: Small Assembly Hall, Town Hall, Luton, "Effective Production Control Records," E. Read, 7.30 p.m.

Wed., Oct. 14.—PETERBOROUGH SECTION: Conference Room, Peterscourt, Peterborough, "Forum,"—Panel: Messrs. H. F. Adams, S. J. Bellamy, J. C. Player and Myron W. Rhotem, 7.30 p.m.

INSTITUTION OF THE RUBBER INDUSTRY

Fri. and Sat., Oct. 9 *and* 10.—The Palace Hotel, Southport, A two-day conference to discuss "Industrial Technical Organisation."

INSTITUTION OF STRUCTURAL ENGINEERS

Tues., Oct. 6.—NORTHERN COUNTIES BRANCH: Neville Hall, Newcastle, Chairman's Address, W. R. Garrett, 6.30 p.m. ★ NORTHERN IRELAND BRANCH: Civil Engineering Department, Queen's University, Belfast, "Prestressed Concrete Manufacture and Construction with Special Reference to a Factory in Northern Ireland," K. Brown, 6.30 p.m.

Thurs., Oct. 8.—NORTHERN COUNTIES BRANCH: Cleveland Scientific and Technical Institution, Middlesbrough, Chairman's Address, W. R. Garrett, 6.30 p.m.

Fri., Oct. 9.—WESTERN COUNTIES BRANCH: University Engineering Laboratories, Bristol, Chairman's Address, Peter Gardiner, Presentation of the Francis Memorial Prizes, 6 p.m.

Mon., Oct. 12.—SCOTTISH BRANCH: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, Chairman's Address, Hugh Fraser, 7 p.m.

Wed., Oct. 14.—YORKSHIRE BRANCH: Metropole Hotel, Leeds, Chairman's Address, E. Lightfoot, 6.30 p.m.

Thurs., Oct. 15.—YORKSHIRE BRANCH: Royal Victoria Hotel, Sheffield, Chairman's Address, E. Lightfoot, 6.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Oct. 2.—FILM EVENING: Pepys House, 14, Rochester Row, Westminster, London, S.W.1, "The Tallylyn Railway—Problems in Preserving a Victorian Narrow-Gauge Railway," 7 p.m.

Wed., Oct. 7.—MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, Annual General Meeting and Chairman's Address, "Some Aspects of Contracts," R. Crawford, 7 p.m.

Fri., Oct. 9.—LONDON SECTION: Pepys House, 14, Rochester Row, Westminster, London, S.W.1, "Some Aspects of Industrial Space Heating," D. E. Edminson, 7 p.m. ★ NORTH WESTERN SECTION: Engineers' Club, Albert Square, Manchester, President's Address, 7.30 p.m.

Mon., Oct. 12.—SHEFFIELD SECTION: Livesey Clegg House, 44, Union Street, Sheffield, 1, Annual General Meeting and Chairman's Address, G. F. Taylor, 7.30 p.m.

LIVERPOOL METALLURGICAL SOCIETY

Thurs., Oct. 15.—Department of Metallurgy, The University, 146, Brownlow Hill, Liverpool, 3, Presidential Address, "The Production and Use of Steel Wire and Steel Wire Ropes," B. Ryan, 7 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS

Fri., Oct. 9.—Engineers' Club, Albert Square, Manchester, 2, Inaugural Address, M. Bentham, 6.45 p.m.

NEWCOMEN SOCIETY

Wed., Oct. 7.—Science Museum, Kensington, London, S.W.7, Annual General Meeting: "Davies Gilbert, Patron of Engineers (1767–1839), and Jonathan Hornblower," A. C. Todd, 5.30 p.m.

SOCIETY OF CHEMICAL INDUSTRY

Wed., Oct. 14.—CORROSION GROUP: 14, Belgrave Square, London, S.W.1, "Fretting Corrosion," K. H. R. Wright, 6 p.m.

SOCIETY OF ENGINEERS

Mon., Oct. 5.—Apartments of the Geological Society, Burlington House, Piccadilly, London, W.1, "Compressed Air in Coal Mines," Neville Smith, 5.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY

Mon., Oct. 5.—CHELTENHAM SECTION: Belle Vue Hotel, Cheltenham, "Record Reproduction Equipment," F. W. Mortimer, 7.30 p.m.

Wed., Oct. 14.—DATA PROCESSING SECTION: Manson House, 26, Portland Place, London, W.1, "An Automatic Analogue Computer for Missile Homing Investigations," J. G. Thomason, 6.30 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE

Fri., Oct. 23.—Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, Presidential Address, J. W. Todd, 6.45 p.m.

REFRACTORY CONCRETE

Saves Time and Money

The ADAPTABLE Refractory Material UP TO 1800°C

The advantages are:

- ✳ FLEXIBILITY OF DESIGN
- ✳ MONOLITHIC CONSTRUCTION
- ✳ LOW INSTALLATION COST
- ✳ AVOIDANCE OF DELAY

REFRACTORY CONCRETE . . .

. . . is ready for use and has a high cold strength at 24 hours.
. . . reduces joints to a minimum.
. . . is stable under load up to 1350°C (with Ciment Fondu) and 1800°C (with SECAR 250).
. . . requires no pre-firing.
. . . does not spall under widest sudden fluctuations of temperature.
. . . can be pre-cast into shapes of practically any size free of distortion.
. . . when made with SECAR 250 has a particularly high resistance to slag attack and reducing atmospheres.

CIMENT FONDU Reg. Trade Mark ALUMINOUS CEMENT — up to 1350°C — WITH SUITABLE REFRACTORY AGGREGATES — up to 1800°C — SECAR 250 REGD. TRADE MARK

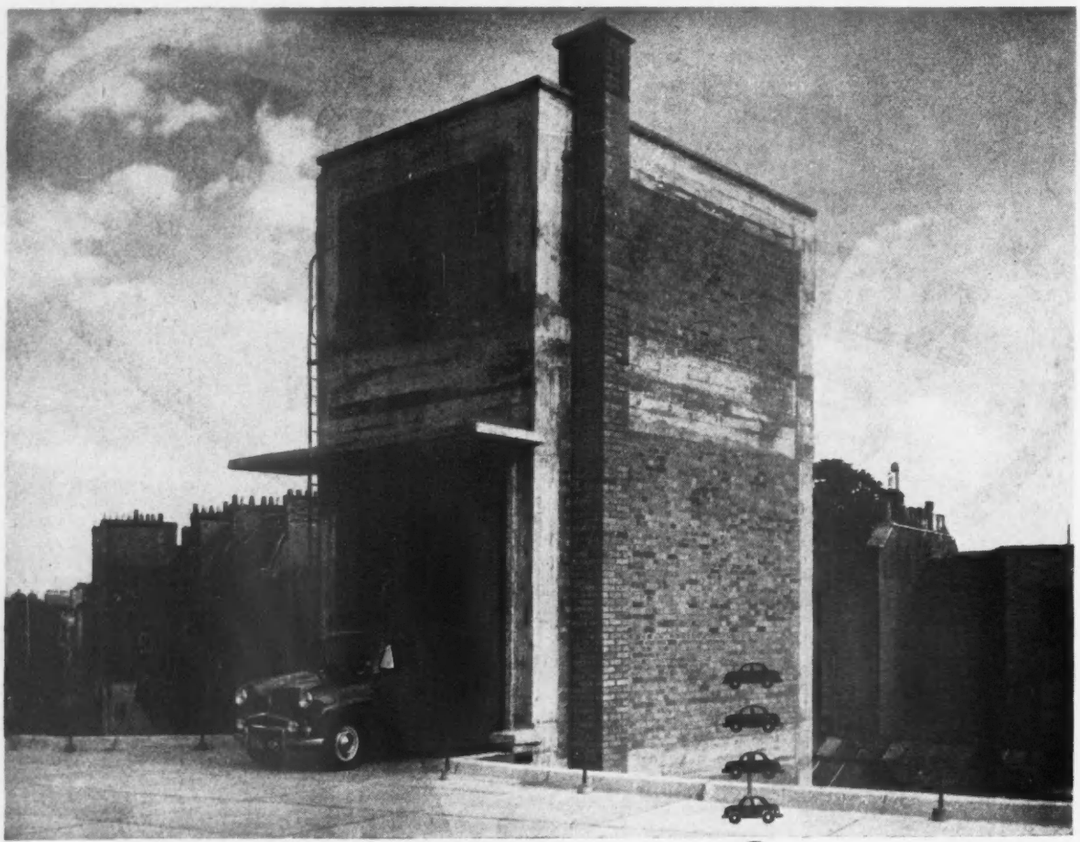
WRITE FOR BOOKLETS 'REFRACTORY CONCRETE' AND 'SECAR 250'

LAFARGE ALUMINOUS CEMENT CO. LTD. 73 BROOK STREET, LONDON, W.1. Telephone: MAYfair 8546

AP67

Enter No. 811 on reply card

M



Architect: C. W. HUTTON F.R.I.B.A.

Car Lift to Roof Car Park

One answer to the car-parking problem is to use roof space. It has been applied by Windmill & Lewis Limited to their garage premises in Merchants Road, Bristol.

Access to the roof and to the intervening floors is by an electric lift designed and installed by J. & E. Hall Ltd.

Specification

Load	3 tons
Speed	50 f.p.m.
Travel	Ground to roof level (3 levels)
Control	Automatic Push Button from car and landings
Dimensions (Internal)	Width — 8′ 6″, Depth — 18′ 6″ Height — 10′ 0″
Landing Doors	Continuous-hinged-shutter type

J. & E. HALL LIMITED

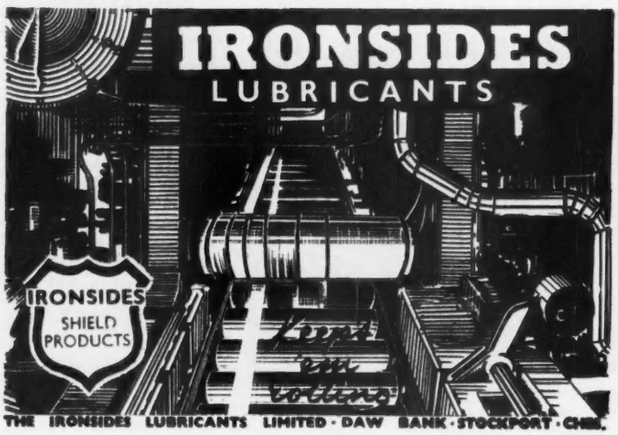
DARTFORD KENT *Tel:* **DARTFORD 3456**

London Office: 10 St. Swithin's Lane, E.C.4. Tel: MANSION HOUSE 9811

LIFT, ESCALATOR AND REFRIGERATION ENGINEERS

AP96

Enter No. 821 on reply card



Enter No. 831 on reply card

RE

PROTOTYPES
EXTREMELY ACCURATE PLATE CAMS
ELECTRONICALLY CONTROLLED CAM MILLING MACHINES
SPECIAL PURPOSE MACHINES

Research Engineers Ltd.,
CANONBURY, N.1
CAN 4244/5/6
Telegrams: "Wilmaket, Nordo, London"

Enter No. 832 on reply card

Harvey & Longstaffe Ltd

Sand Casting Specialists in

MANGANESE BRONZE

ALUMINIUM BRONZE

HIGH CONDUCTIVITY COPPER

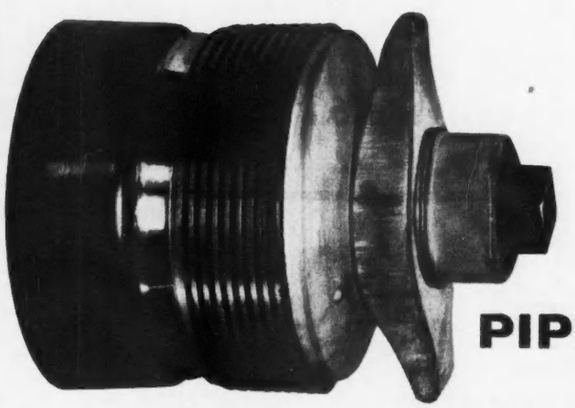
HIGH STRENGTH ALUMINIUM ALLOYS

Send your enquiries to the firm at the top

Head Office and Foundry
PIERCY STREET. ANCOATS, MANCHESTER, 4.
Tel: No. COLlyhurst 1503/4

Enter No. 833 on reply card

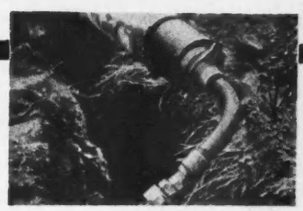
AT LAST! **An economical, safe and easy-to-use device for plugging open-ended pipes for pressure testing and pigging.**



THE G.D. CONE LOCK PIPE STOPPER

The higher the pressure, the tighter the stopper

Pressure testing of open-ended steel pipes and pipe fittings is considerably simplified with the aid of cone lock pipe stoppers. These tools are designed to withstand test pressures of up to 2000 lbs./sq. in. and can be used successfully for any application where a simple, efficient and reusable seal is required. For further details, ask for our leaflet "Cone Lock Pipe Stoppers."



The cone lock pipe stopper in position.

The stopper is easily removed after testing by slackening the wing nut.

GENERAL DESCALING CO. LTD.

RETFORD ROAD, WORKSOP, NOTTS.
Telephone: Worksop 3211/3

Enter No. 834 on reply card

Here is the perfect jointing for high pressure smooth surface or screw unions!

Tested and recommended by the Ministry of Supply (MTV Branch) Reference No. VG.6/300/FIR for export to tropical countries.

OSOTITE—the modern scientific sealing which has been proved by rigorous tests to be the perfect jointing for smooth surface and screw unions. OSOTITE is a simply applied liquid compound, impervious to heat, petrol, oil, grease, water and steam which ensure in a few minutes a HIGH PRESSURE GAS, AIR or WATER-TIGHT JOINT. Write for full details and prices.

OSOTITE

A SLICK PRODUCT

SLICK-BRANDS LIMITED
WADDON CROYDON

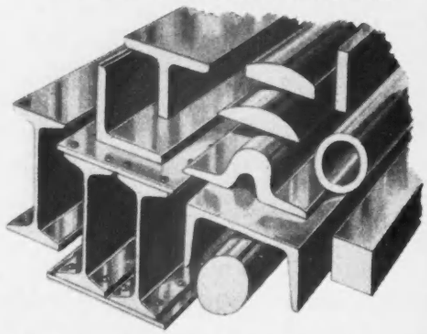
570

Enter No. 841 on reply card

STEEL

SHEETS PLATES AND SECTIONS • BRIDGE RAILS • IRON & STEEL MERCHANT BARS • HOOP • STRIP • CHEQUERED PLATES

SHEARED·COLD SAWN & PROFILE CUT TO ALL THICKNESSES & SHAPES



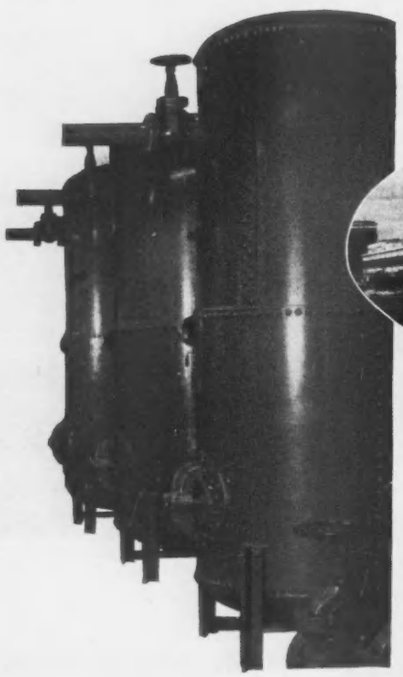
HALL BROS (WEST BROMWICH) LTD

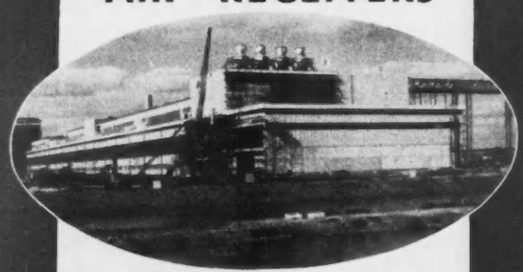
EAGLE WORKS · GREETS GREEN
WEST BROMWICH

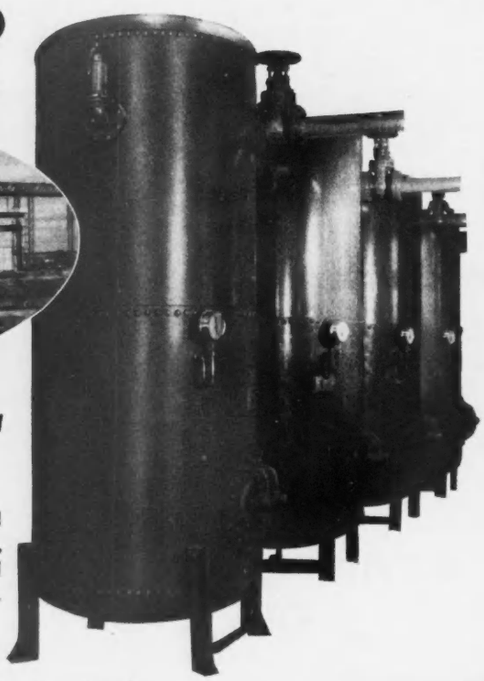
Telephone: TIPTON 1611 *(10 lines)*

Enter No. 842 on reply card

FARRAR
AIR RECEIVERS







Installed at the New Ford Motor Company Limited foundry at Dagenham - Essex.

These photographs were kindly supplied by The Ford Motor Company Limited, to whom our acknowledgments and thanks are due for permission to publish.

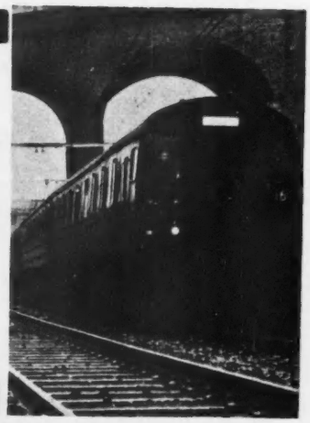
• • • • TRADE MARK • • • •

THE FARRAR BOILERWORKS LTD. NEWARK (Notts) ENGLAND

TELEGRAMS FARRAR NEWARK 1143 ★ ★ ★ ★ ★ ★ ★ TELEPHONES NEWARK 1143-4-5

Enter No. 843 on reply card

HOT GALVANIZING IS THE BEST PROTECTION



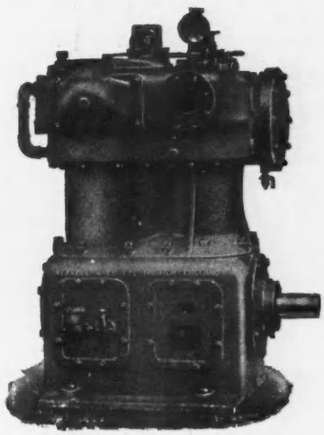
For further information write to
the Hot Dip Galvanizers Association
34 Berkeley Square London W.1

Enter No. 851 on reply card

AIR COMPRESSORS

VERTICAL SINGLE-ACTING TYPE

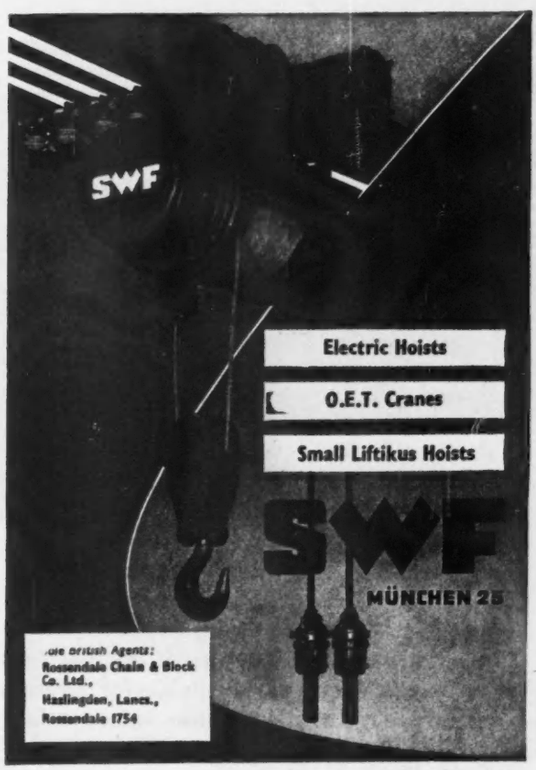
SINGLE STAGE.	100 LB. PER SQ. IN.	1 TO 155 CU. FT. PER MIN.
	60 LB. PER SQ. IN.	1 TO 380 CU. FT. PER MIN.
TWO STAGE.	100 LB. PER SQ. IN	200 TO 310 CU. FT. PER MIN.



FOR PARTICULARS OF THESE COMPRESSORS AND FOR OTHER TYPES AND SIZES.
TELEPHONE : IPSWICH 56124 (3 LINES)
TELEGRAPH : "REAVELL, IPSWICH" OR WRITE TO:—

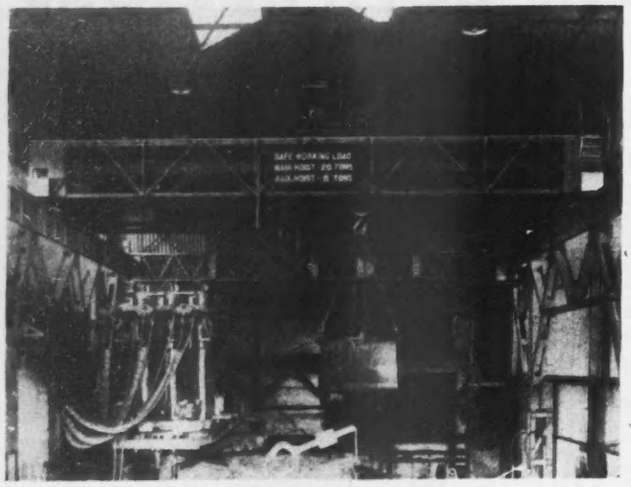
REAVELL & CO., LTD.
IPSWICH - ENGLAND

Enter No. 852 on reply card



SWF,
17 Baierbrunner Strasse, Munich 25,
Bavaria, Federal Republic of Germany.

Enter No. 853 on reply card



ANDERSON

OVERHEAD CRANES

A FIRST CHOICE IN

FOUNDRIES · POWER STATIONS · STEELWORKS

WORKSHOPS · STOCKYARDS

and EVERYWHERE that absolute reliability, efficiency and speedy handling are required and modern design and construction with unsurpassed workmanship are appreciated.

ALSO LEADING MAKERS OF DERRICK CRANES

TELEPHONE:
CARNOUSTIE 2214/5
TELEGRAMS:
"DIAMOND" CARNOUSTIE

ANDERSON
THE ANDERSON-GRICE CO. LTD.
TAYMOUTH ENGINEERING WORKS, CARNOUSTIE, SCOTLAND

LONDON OFFICE:
FINSBURY PAVEMENT HOUSE,
120, MOORGATE, E.C.2.
TELEPHONE: MONarch 4629

Enter No. 861 on reply card

MIRRLEES IMO PUMPS

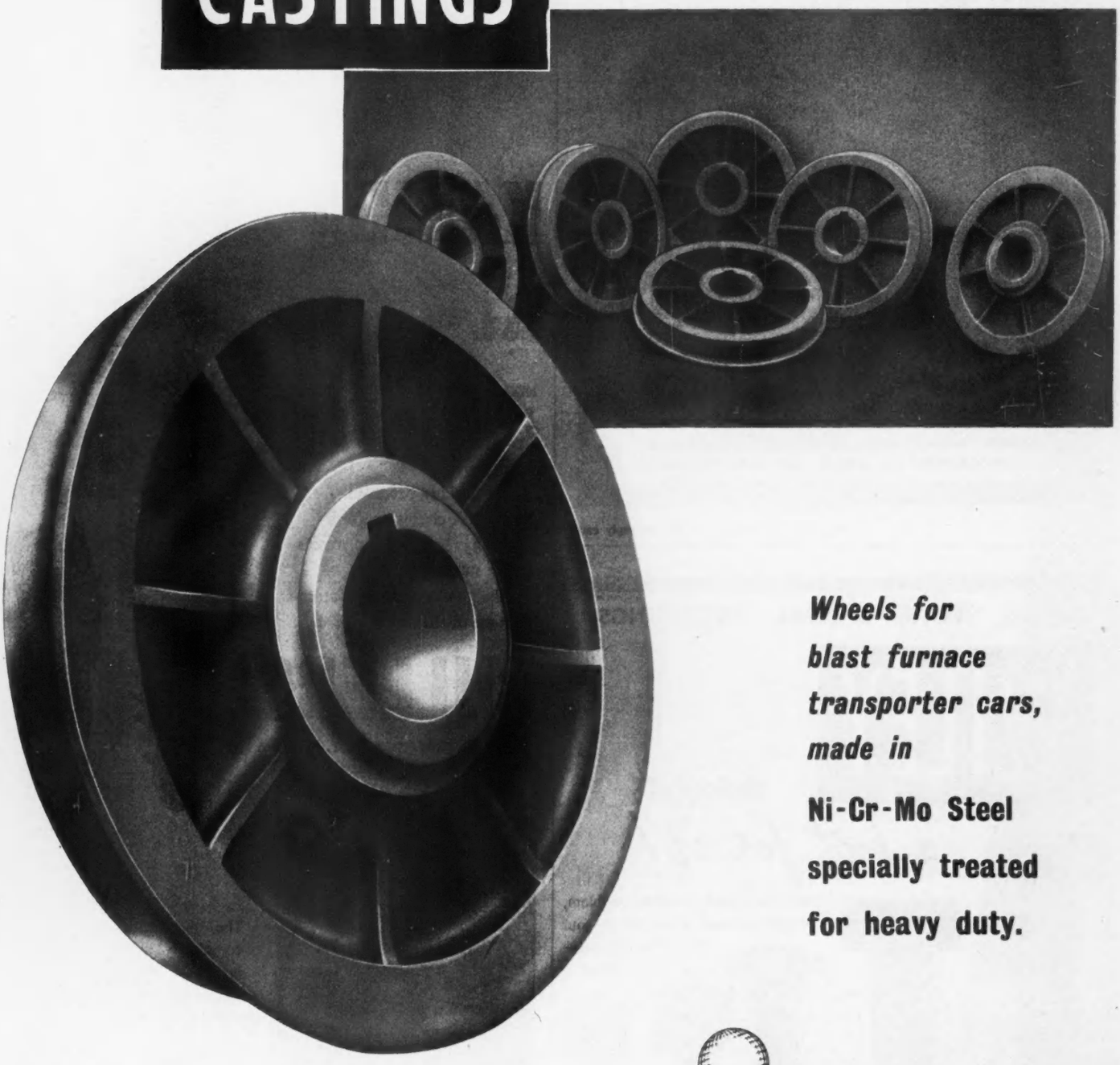
GLUTTONS FOR WORK

The Extra large suction port of these Mirrlees Imo Pumps ensures the easy flow of viscous fluids into the pump. They can handle such fluids as Viscose, Grease, etc., without pulsation or emulsification, thus perpetuating all the virtues of the Mirrlees Imo Pumps which are available for a range of designs for most oils. Fuller information will be sent on request.

MIRRLEES (ENGINEERS) LTD.
(SUBSIDIARY OF THE MIRRLEES WATSON CO., LTD.)
EARL HAIG ROAD, HILLINGTON, GLASGOW, S.W.2. London Office: 38 GROSVENOR GARDENS, S.W.1

Enter No. 862 on reply card

STEEL CASTINGS



Wheels for blast furnace transporter cars, made in

Ni-Cr-Mo Steel specially treated for heavy duty.

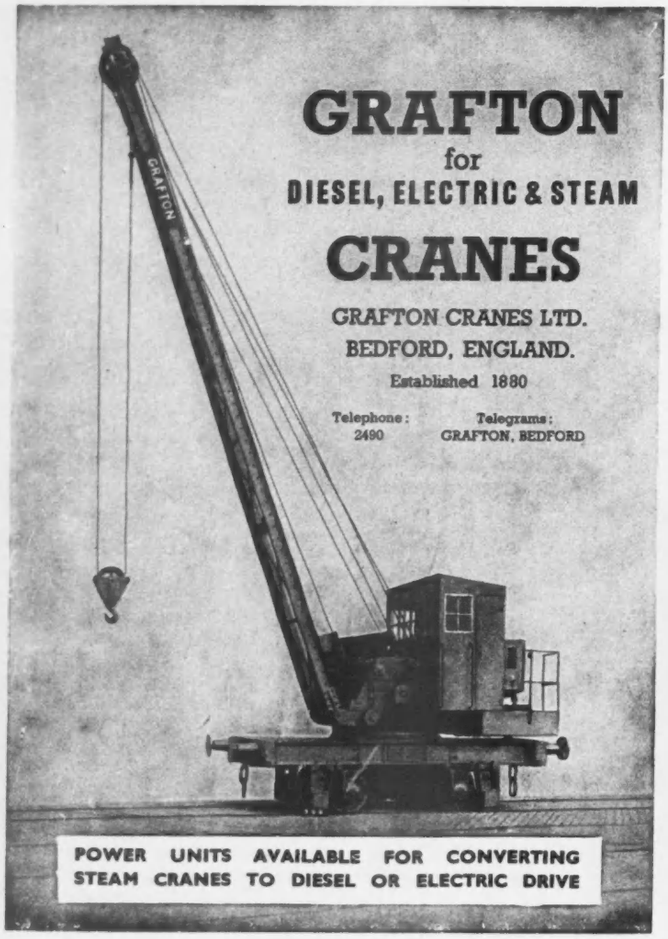
by

FIRTH BROWN

ALLOY STEELMAKERS . FORGEMASTERS . STEEL FOUNDERS . HEAVY ENGINEERS

THOS FIRTH & JOHN BROWN LIMITED SCUNTHORPE ENGLAND

Enter No. 871 on reply card



Enter No. 881 on reply card

BOLTS, NUTS, SPECIAL FASTENINGS

WILEY

make a bolt for it!

Whatever your fastening problem, Wiley can make a bolt for it—and a nut too—ask them!

JAMES WILEY & SONS LTD., DARLASTON

Telephone: James Bridge 2692

MW56

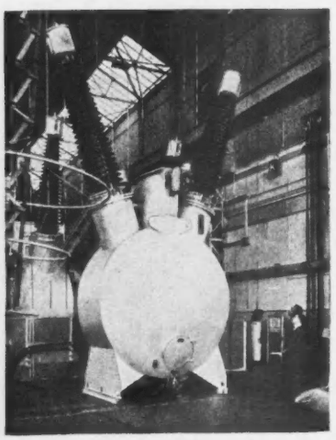
Enter No. 882 on reply card

KARIBA at 330 kV.

All the bushing porcelains for the 330 kV. circuit breakers
All the 330 kV. strain insulators for the substations
and the 330 kV. post insulators for some of the substations by

BULLERS

MAIN CONTRACTORS · B.T.H. Co. Ltd.
Consulting Engineers · Merz & McLellan



The illustrations show a complete 330 kV. bushing insulator and a 330 kV. circuit breaker, by courtesy of the B.T.H. Co.

BULLERS LIMITED · MILTON · STOKE-ON-TRENT · STAFFS

Telephone: Stoke-on-Trent 54321

London: 6 Laurence Pountney Hill, E.C.4. Tel.: MANsion House 9971

Enter No. 883 on reply card

THE LARGEST RANGE OF CLUTCHES IN GREAT BRITAIN

Borg & Beck clutches are now available in the following range of dry plate clutches:

SINGLE PLATE
6¼", 7¼", 8", 9", 10", 11"

TRIPLE PLATE CLUTCH FOR RACING CARS
7½"

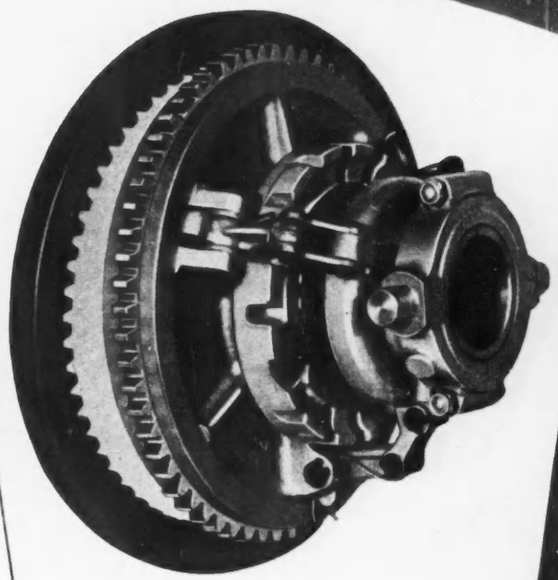
STRAP-DRIVE SINGLE-PLATE CLUTCHES
12", 13", 14", 15"

HEAVY-DUTY SINGLE-PLATE CLUTCHES
14" R4, 16" R5, 18" R4

HEAVY-DUTY TWIN PLATE
18" R4

INTEGRAL CLUTCH AND POWER TAKE-OFF
10", 11"

BORG & BECK
REGD. TRADE MARK
specialists in the transmission of power
FRICTION CLUTCHES—MANUMATIC SYSTEMS



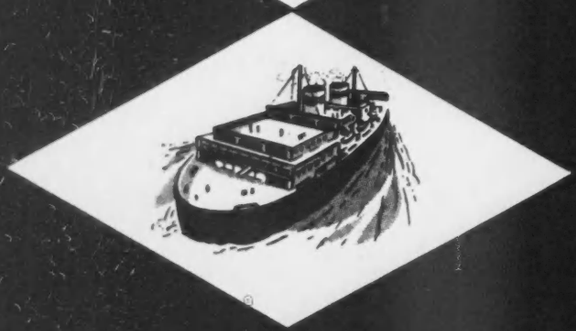
The Rockford range of clutches now comprises the following:

5½"
7½"
10"
11½"
11½" twin
14" single
14" twin
13" single plate cam-type
16" twin-plate cam-type

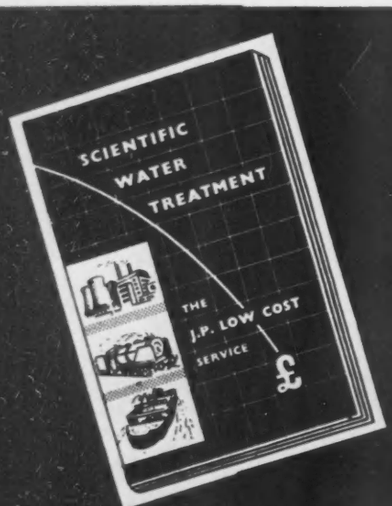
ROCKFORD
OVER-CENTRE CLUTCHES AND POWER TAKE-OFF UNITS

Enter No. 891 on reply card
N

INTERNAL WATER TREATMENT FOR BOILERS



John Pittam & Co.



Full technical information on the method of **J.P.** *Water Treatment is explained in the Brochure sent free on receipt of the coupon.*

JOHN PITTAM & CO.

(Division of Tannin Developments Ltd)

London Office:

The Adelphi, John Adam Street
London, W.C.2.

Telephone: WHItehall 6777

Works:

Ditton, Nr. Widnes, Lancs.

Telephone: Widnes 2465

Please send the J.P. Brochure to:—

FIRM .....

ADDRESS .....

.....

For the attention of .....

you too can be in clover with a SPEEDICUT "CHIPBREAKER" DRILL

Drilling mild steel components with a SPEEDICUT "CHIPBREAKER DRILL our customer drills 17,000 ½" diameter holes before regrinding. The finish of the holes is excellent and the long life between regrinds enables the maximum advantage to be taken of advanced automatic machine tools.

Take advantage of the latest techniques in tool making—SPECIFY SPEEDICUT.

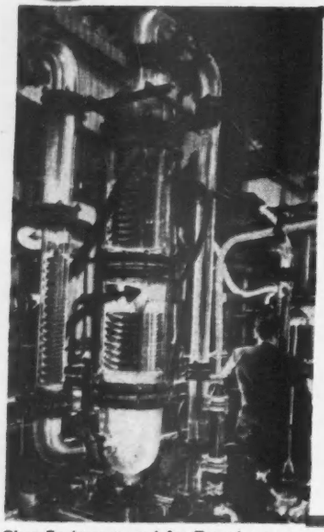
F.T.T. FIRTH BROWN TOOLS LTD.
SPEEDICUT WORKS, CARLISLE STREET EAST,
SHEFFIELD, ENGLAND

Enter No. 911 on reply card

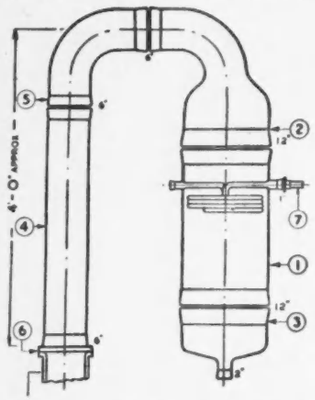
REFLUX & DISTILLATION using QUICKFIT Visible Flow GLASS HEAT EXCHANGERS

A folder is available giving full descriptive details of this Unit. This folder also contains full information on four other Reflux and Distillation Units which are easily assembled from standard Q.V.F. Glass components.

Write for your copies of the "REFLUX - DISTILLATION" Folder and for the Q.V.F. Catalogue "Glass for Industry."



Glass Equipment used for Toxaphene production
(Photo by courtesy of Cocker Chemical Co. Ltd.)



Unit RD57/D6 — Overhead Glass Distillation equipment generally used in conjunction with enamelled metal or similar vessels; made up of Q.V.F. standard glass components

Item No.	Description	Cat. Ref.	Qty.
1	Heat Exchanger	HE.12/25	1
2	12" to 6" Pipe Bend Reducer	PBR.12/6	1
3	12" to 2" Pipe Reducer	PR.12/2	1
4	6" Pipe Section, 37" long	PS.6/36	1
5	6", 90° Bend	PB.90/6	1
6	6" Glass Spacer, ¾" thick	SS.6/¾	1
7	1" Hose Connector (Metal) complete	MHC.1	3

PARTS LIST for assembly of Unit RD57/D6 with Q.V.F. standard glass components

The Chemical Engineers in Glass Q V F LIMITED
DUKE ST. · FENTON · STOKE-ON-TRENT · STAFFORDSHIRE
Tel: LONGTON, STAFFS 32104-8 'Grams: Q.V.F., STOKE-ON-TRENT, TELEX

Enter No. 921 on reply card

Wise businessmen know...

...

AUTOHALL'S
CONTRACT CAR HIRE
AT THE LOWEST RATES IN EUROPE

on 1 & 2 year contracts

inevitably saves their company money

ALSO ✳ SELF-DRIVE HIRE
✳ CHAUFFEUR DRIVEN

Again at the lowest rates in Europe

AUTOHALL

DEPT. 10, 302 KING STREET,
HAMMERSMITH, LONDON, W.6.
Telephone: RIVerside 8781
Cables: Autohall, London.

1959 CARS

You can now hire a new car at lower cost than you can own one yourself.

Company Car Fleet can be had without capital outlay.

Current models always at your disposal.

No servicing or maintenance worries.

Know the cost of car operation at least 12 months in advance.

For example:

Ford Popular £180 per year
Ford Anglia £210 per year
Ford Consul
or Austin A55 £290 per year

Also short period hire at London's lowest rates. One day hire from 17/6d. per day including 35 miles and 1959 Chauffeur driven cars for 1/3d. per mile.

Special facilities for all overseas visitors.

CLIP AND POST THIS ADVERTISEMENT FOR FREE BROCHURE DESCRIBING THE EXCITING NEW OFFER. ALSO NEW BROCHURE DESCRIBING FORTHCOMING EVENTS IN BRITAIN.

NAME .....

.....

ADDRESS .....

.....

.....

.....Ref. No. 10

Enter No. 922 on reply card

Tangye Jack

IS PROUD OF THE NEW 100 TONS MODEL

Hydralite

because it incorporates

THE NEW HYDRAULIC HAND PUMP

Yes, we practise what we preach. The Hydrapak is an ideal hand pump for the 100 tons capacity Hydralite, the largest jack in this lightweight range. A Jack of such capacity requires many additions not called for on a smaller jack such as a 'pre-fill' facility. This two-speed pump, when operated on low pressure, will pre-fill and lift up to 10 tons on the jack, enabling the ram to be quickly brought into contact with the work. Changeover to high pressure is by push button enabling the jack to lift 100 tons with an easy movement of the operating handle.

Let 'Tangye Jack' enter your works. He will bring you a power of good.

Get catalogues to-day for future quick reference.

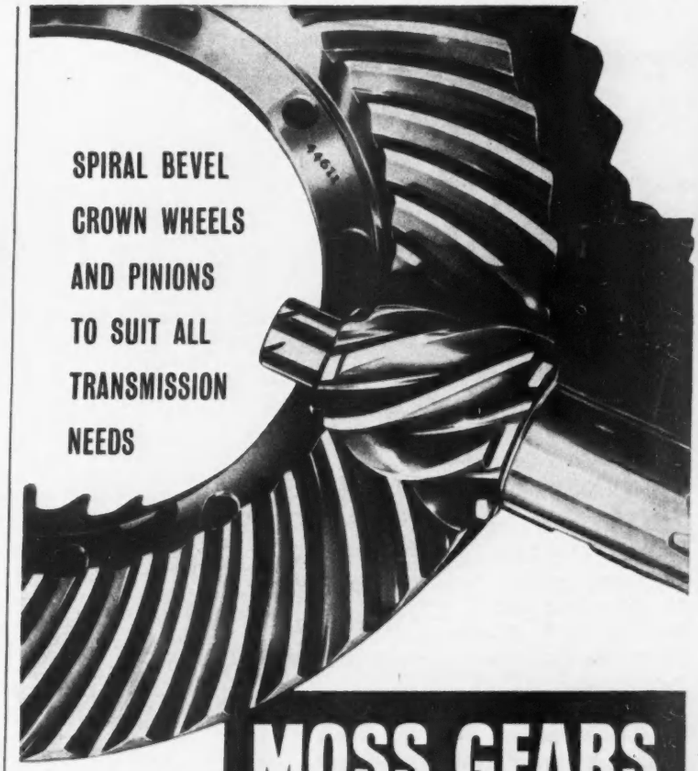
AREA OFFICES AT LONDON, MANCHESTER AND GLASGOW.

TANGYES LIMITED
SMETHWICK · BIRMINGHAM

TELEPHONE: SMETHWICK 1181 GRAMS: TANGYES BIRMINGHAM

AD No. 448

Enter No. 931 on reply card



SPIRAL BEVEL CROWN WHEELS AND PINIONS TO SUIT ALL TRANSMISSION NEEDS

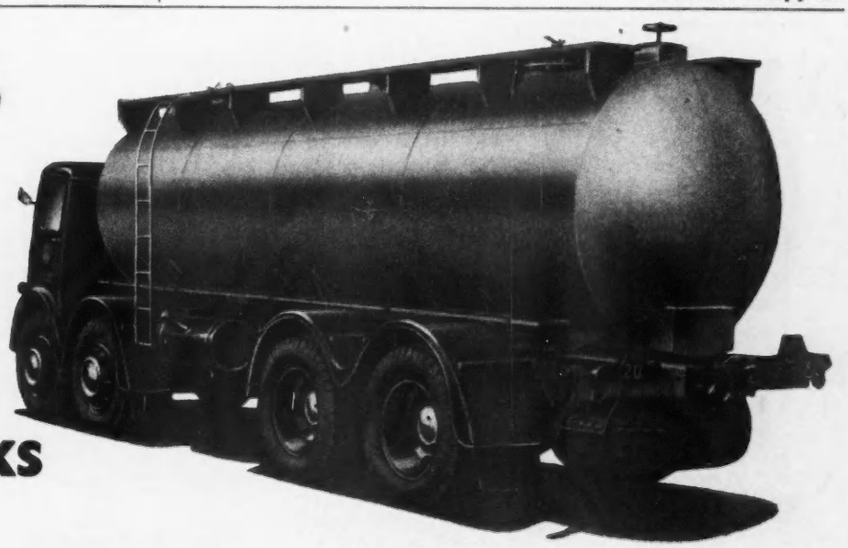
MOSS GEARS

MOSS GEAR CO. LTD · CROWN WORKS · TYBURN · BIRMINGHAM · 24

Telephone: ERDington 1661/6. Telegrams: 'Mosgear Birmingham'.

Enter No. 932 on reply card

WELDED NICKEL ROAD TRANSPORT TANKS



fabricated by

Illustrated: 3,090 gallon single compartment Nickel Road Tank for 'Phenol,' Mounted on Foden F.G. 6/24 chassis.

For Imperial Chemical Industries Ltd.

Butterfields of SHIPLEY

W. P. Butterfield Ltd Box 38 Shipley Yorkshire
Telephone: 54244 (8 lines)
Branches: London. Tel. HOLborn 2455 (4 lines)
Birmingham. Tel. EAS 0871 and EAS 2241. Bristol. Tel. 27905
Liverpool. Tel. CENtral 0829. Glasgow. Tel. CENtral 7696.
Dublin. Tel. 73475 and 79745

Butterfield craftsmen carry out welding with the most up-to-date equipment and at all stages of fabrication it is supervised by experts to any of the recognised codes

This includes the highest specification demanded by Nuclear Energy Establishments

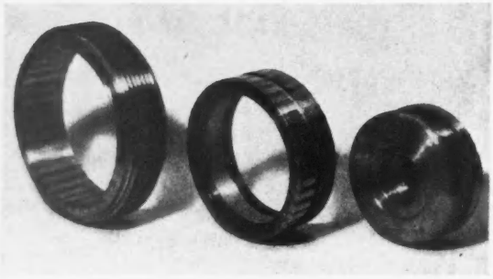
We are equipped with WELD X-RAY PLANT, MATERIALS TESTING METALLURGICAL CHEMICAL and MICROSCOPIC EXAMINATION LABORATORIES FOR ANY REQUIRED CLASS OF WORK

Enter No. 933 on reply card

SULZER

ROTAFLUX ELECTROMAGNETIC COUPLINGS

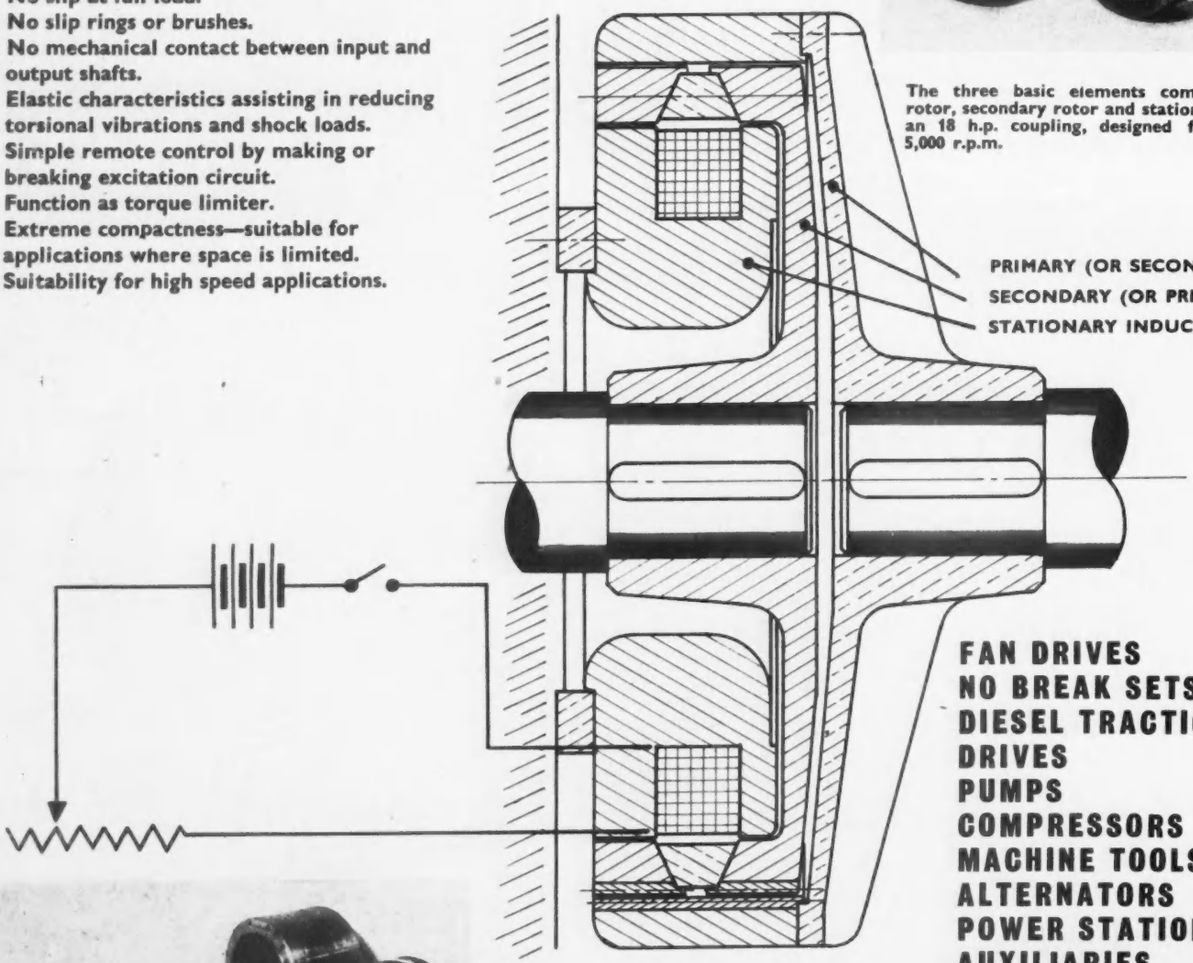
A Synchronous Transmission in Which the Primary and Secondary Shafts are Connected Through Electromagnetic Induction



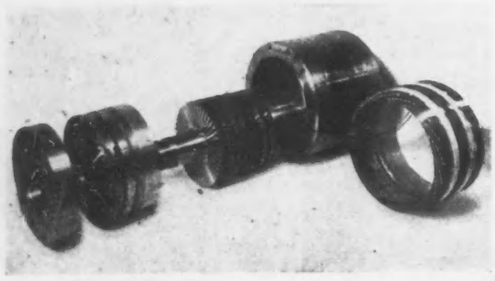
The three basic elements comprising primary rotor, secondary rotor and stationary inductor, of an 18 h.p. coupling, designed for 19 ft.lb. at 5,000 r.p.m.

Features of the transmission include:—

Progressive smooth and controlled starting.
No slip at full load.
No slip rings or brushes.
No mechanical contact between input and output shafts.
Elastic characteristics assisting in reducing torsional vibrations and shock loads.
Simple remote control by making or breaking excitation circuit.
Function as torque limiter.
Extreme compactness—suitable for applications where space is limited.
Suitability for high speed applications.



FAN DRIVES
NO BREAK SETS
DIESEL TRACTION MAIN DRIVES
PUMPS
COMPRESSORS
MACHINE TOOLS
ALTERNATORS
POWER STATION AUXILIARIES
BRAKES AND WINCHES
TEXTILE MACHINERY
Etc., Etc.



Elements of a disc type coupling arranged as torque limiter and designed for 13,000 ft.lb. at 2,350 r.p.m.

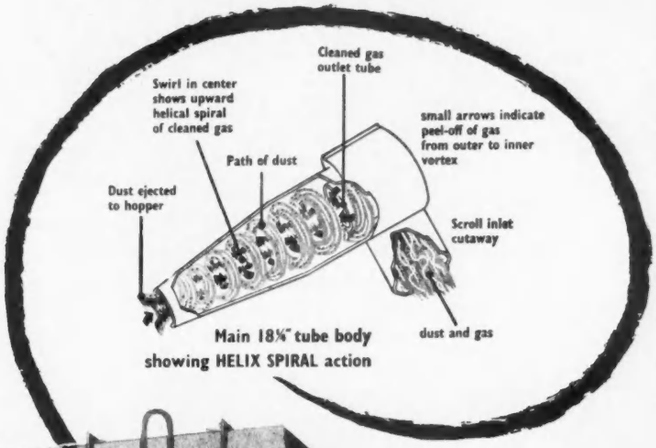
SULZER BROS. (LONDON) LTD., 31 Bedford Square, London, W.C.1
(INCORPORATING HATHORN DAVEY & CO. LTD.)

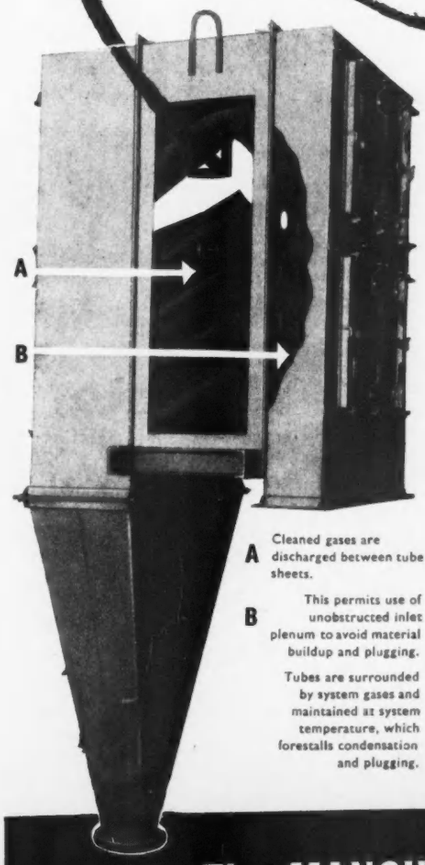
"ROTAFLUX" is manufactured under licence from COMPAGNIE DE CONSTRUCTION MECANIQUE PROCEDES SULZER, PARIS.

Enter No. 941 on reply card

MANCUNA - DUSTEX pays its way

- *In profitable product recovery*
- *In trouble-free dust control*


Cleaned gas outlet tube
Swirl in center shows upward helical spiral of cleaned gas
small arrows indicate peel-off of gas from outer to inner vortex
Path of dust
Dust ejected to hopper
Scroll inlet cutaway
dust and gas
Main 18¾" tube body showing HELIX SPIRAL action



A Cleaned gases are discharged between tube sheets.

B This permits use of unobstructed inlet plenum to avoid material buildup and plugging.

Tubes are surrounded by system gases and maintained at system temperature, which forestalls condensation and plugging.

A REVOLUTIONARY NEW UNIT-CAST DESIGN

This cutaway miniature cyclone tube from the tube bank of the new Mancuna-Dustex Collector shows why efficiency is so high and maintenance negligible. The scroll inlet establishes a velocity which is maintained through its powerful vortex—the dust travelling downward in an outer vortex to the hopper while the cleaned air moves upward in an inner vortex to the outlet tube for discharge between tube sheets. D-584 tubes are available in abrasion-resistant cast iron, non-sparking cast aluminium or stainless steel. Note the one-piece cast tube design with minimum ¼" wall thickness which increases tube life and performance.

The MANCUNA - DUSTEX

D-584 MINIATURE CYCLONE COLLECTOR

MANCUNA ENGINEERING LIMITED,

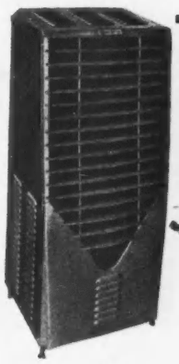
Denton, Manchester. Tel: DENton 3965 (5 lines)

London Office: 59, Victoria Road, Surbiton, Surrey. Phone: Elmbridge 9793

SPECIALISTS IN GAS CLEANING AND DUST TECHNOLOGY.

MANCUNA

Enter No. 951 on reply card



HEAT in a HURRY!

THAT'S THE PURPOSE OF

Bering

Free-standing model illustrated. Also available for wall mounting.

Oil-fired (forced draught burner) for economy. Hot air distributed by powerful fan for quickest possible warm-up. Instant heat on/off control.

Prices (Ex-Works) from

£59 10s. 0d.
Manual Control

£66 10s. 0d.
Thermostatic

Free-standing or wall-mounting models in single or multiple units according to area and heat output required, installed without interruption to normal production or activity.

OIL-FIRED FAN-DRIVEN

HEATING UNITS

Running costs from approx. 5d. AN HOUR

In a hurry to reach you . . . in a hurry to serve you . . . in a hurry to blow heat to every corner of your factory, workshop, warehouse, foundry, office, showroom, store, hall, gymnasium or school. Models suitable for as little as 15,000 cu. ft. and, in multiple units, for as much as 150,000 cu. ft.

The cheapest possible heating system . . . and the finest!

There is no other system with as quick a heat-up or with as rapid heat distribution as Bering; none so easily and quickly installed; none so "quick on the job"! Reliable, efficient, clean.

WRITE NOW for details

BERING ENGINEERING LIMITED
(Dept. ENG./A.),
Doman Road, Camberley, Surrey.
Telephone: Camberley 4191 (3 lines)
(one of the Bering Group of Companies)

Enter No. 952 on reply card

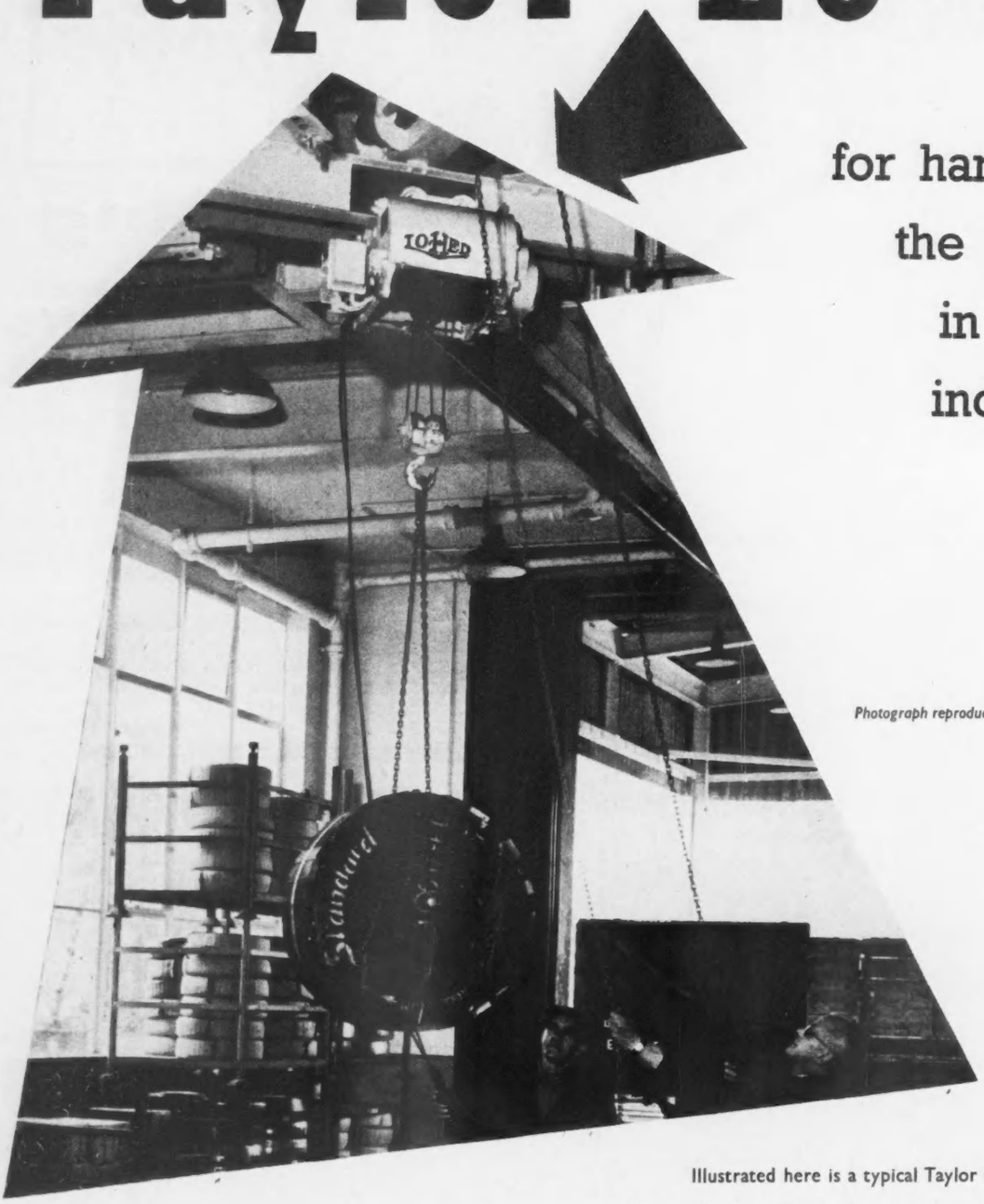
MINIATURE RELAYS

LONDEX LTD. ANERLEY WORKS, LONDON, S.E.20

Telephone: **Sydenham 3111 (5 lines)**

Enter No. 953 on reply card

Taylor Lo-Hed



for handling the loads in your industry

Photograph reproduced by kind permission of Standard Telephones & Cables Ltd., Newport, Monmouthshire.

Electric Hoists, Overhead Travelling Cranes

Electric Winches and Capstans

Transporter Hoists

Skip Hoists and Cupola Chargers

Runway Structures

Illustrated here is a typical Taylor Lo-Hed Hoist installation for handling cable drums in the despatch department.

For *your* industry, factory or process, there is a wide range of Lo-Hed equipment available.

Send us your enquiries, your problems or specifications of equipment required.

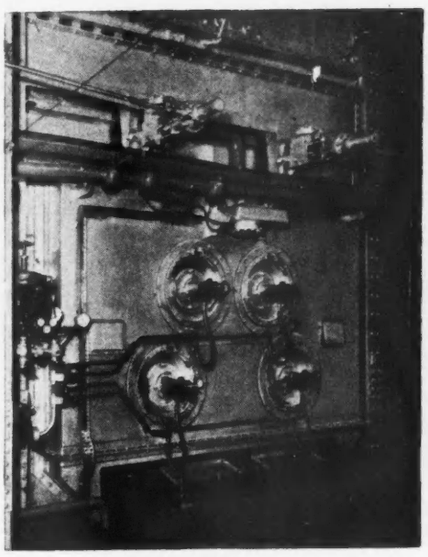
TAYLOR STOKER COMPANY, LIMITED,

MATERIALS HANDLING DIVISION

189/191, Drummond Street, Euston, London, N.W.1

Phones : EUSton 4102, 4103 and 4143

Enter No. 961 on reply card



GLAXO LABORATORIES LTD.
have installed

THORNYCROFT

OIL BURNING EQUIPMENT

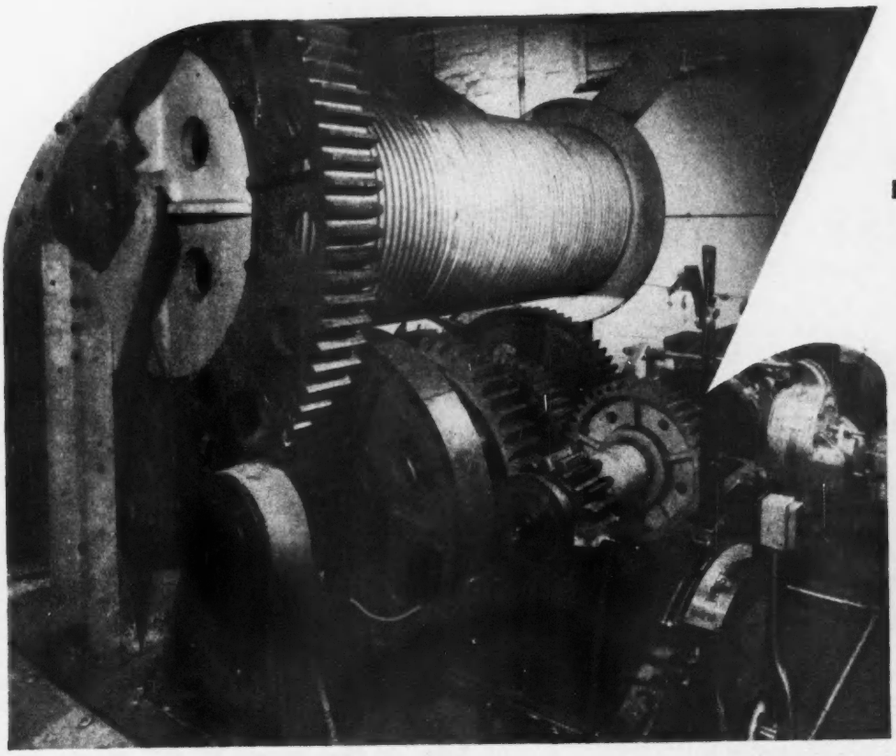
on their Babcock & Wilcox Water Tube Boilers at Greenford. We supplied the whole of the oil firing equipment and the conversion from solid fuel to oil firing was engineered by our technical staff.

Other recent Thornycroft installations include those at Selfridges Ltd., London Airport, Lewis's Ltd. Leeds Store, Shell-Mex House and several for the Ministry of Works : that at Broadcasting House is nearing completion.

For particulars of industrial equipment write for publication S.E.B.99 which includes a questionnaire for completion and return to us.

JOHN I. THORNYCROFT & CO. LIMITED, WOOLSTON WORKS, SOUTHAMPTON

Enter No. 971 on reply card



ABBOT

MACHINE CUT GEARS

All types...in any material...

to specification...

We guarantee the teeth of all wheels cut by us to be correct, and all work is examined and checked before being despatched. Each gear wheel of a pair is run in correct relative position to the other in a special gear-testing machine.

Our booklet "MACHINE CUT GEARS" contains much information of interest and use to engineers. A copy will be sent on request.

The ABBOT ENGINEERING Co. Ltd.
22 SMITHHILLS **PAISLEY**
Telephone : PAISLEY 4272 *Telegrams : "ABBOT, PAISLEY"*

SPUR WHEELS · SPIRAL WHEELS · RACKS · WORM GEARING · BEVEL WHEELS · FIBRE PINIONS

Enter No. 972 on reply card

We supply

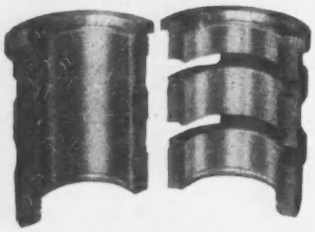
COMPLETE PLANT
for
Waste Recovery
and
Effluent Treatment

NORRIS BROS. LTD.
53 VICTORIA STREET, S.W.1
Tel: Abbey 6132
DESIGNERS AND SUPPLIERS OF ALL PROCESS PLANT

Enter No. 981 on reply card

Wheatley & Whiteley

BEARING RECONDITIONING



ANY SIZE UP TO 12" SHAFT DIAMETER
99, Kirkstall Rd., Leeds, 3 Tel. 31122

Enter No. 982 on reply card

1959

Clarity at Sight . . .

with ENM counters designed to show facts with speed and accuracy

Discerning manufacturers install ENM Indicating and Printing Counters as original equipment on their products, giving users control over quantity, length and time.

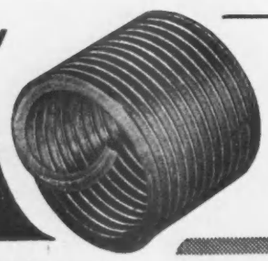
MEASURE
RECORD
CONTROL

ENM

ENGLISH NUMBERING MACHINES LIMITED
Leading Manufacturers of Counting and Numbering Devices

Enter No. 985 on reply card

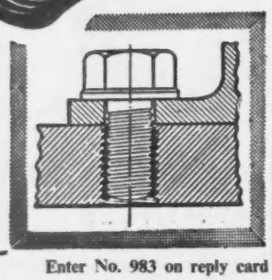
Better than New with a . . . .



Cross

BRITISH WIRE THREAD INSERT
PRECISION MADE in CARBON STEEL for ALUMINIUM and MAGNESIUM.
We also make Stainless and Bronze for other applications.

CROSS MANUFACTURING CO. (1938) LTD.
Tel: Combe Down 2355-8 BATH, SOMERSET Grams: Circle, Bath
Specialists in JET ENGINE LABYRINTHS, CIRCLIPS, SPRING WASHERS, SPRINGS, etc.



Enter No. 983 on reply card

MORE Schieldrop Industrial Oil Burners are used by
MORE and more leading engineers and
MORE Schieldrop S.P.O. Burners have been sold
IN GREAT BRITAIN **MORE** than any other make

LONDON Tel : Belgravia 3785
MANCHESTER Tel : Blackfriars 3851
SCOTLAND Tel : Kilmacolm 279
SWANSEA Tel : Swansea 4951
BIRMINGHAM Tel: Erdington 2772

Schieldrop Industrial Burners
SCHIELDROP & CO. LTD., STOTFOLD BEDS · Tel 414 (4 lines)

Enter No. 984 on reply card

I'll swop you my Swallowglide for your Uniglide

NO! That can't be done. Harland Swallowglide and Harland Uniglide pumpsets are **NOT** interchangeable—each is built for a specific duty. Uniglides are for handling usually clean water, whilst Swallowglides are for pumping slurries, sludges and solids in suspension.

But you will be glad you changed to Harland pumpsets. You have purchased reliability, efficiency, easy maintenance and a first rate overall engineering service. Swallowglides can be mounted vertically or horizontally. The impeller is designed to be unchokeable. They handle sewage, effluents, waste fibrous materials, offals and pulps, sweepings, syrups, oils and greases, potatoes and peas, and sludges and slurries of all kinds.

Uniglides are single stage pumps designed for maintained maximum efficiency and reliability. All rotating parts are dynamically and statically balanced, ensuring smooth running and long life. The casings are split horizontally with suction and delivery branches formed in the lower half. This feature, and split glands, facilitate maintenance.

For more specific information ask for these leaflets:—Uniglide No. 110/1.
Swallowglide No. 180/1.

HARLAND pumps

THE HARLAND ENGINEERING CO. LIMITED

Alloa Scotland Phone Alloa 390 London Office: Harland House 20 Park Street London W1 Phone Grosvenor 1221
Branches: Bristol Glasgow Leeds Timperley (Cheshire) Newcastle-upon-Tyne Nottingham Wolverhampton and overseas.

G.8 P.173

Enter No. 991 on reply card

METRO-CAMMELL

Success of **LIGHT ALLOY CONSTRUCTION** *earns* **REPEAT ORDER**

LONDON TRANSPORT

METROPOLITAN-CAMMELL CARRIAGE & WAGON CO. LTD.

HEAD OFFICE: SALTLEY · BIRMINGHAM 8—LONDON OFFICE: VICKERS HOUSE · BROADWAY · WESTMINSTER · S.W.1.

Enter No. 1001 on reply card

THE BEST PEOPLE TO SETTLE ALL YOUR DUST PROBLEMS ARE...

You state the PROBLEM
We supply the ANSWER
and you will be SATISFIED

STURTEVANT

Write to our reference Z/101/E

STURTEVANT ENGINEERING CO. LTD.
Southern House, Cannon Street, LONDON, E. C. 4.

AUSTRALIA: STURTEVANT ENGINEERING CO. (AUSTRALASIA) LTD. 400 SUSSEX STREET SYDNEY N.S.W.

Enter No. 1002 on reply card

DARWINS
TOOL STEELS

A WIDE
RANGE OF
QUALITIES
FOR ALL
TOOLING
PURPOSES

WRITE FOR LITERATURE AND STOCK LIST

DARWINS LIMITED

FITZWILLIAM WORKS · SHEFFIELD
TELEPHONE: SHEFFIELD 49049 TELEX No.: 54-215

Enter No. 1011 on reply card

The first passenger hoist for use in the Building and Civil Engineering Industries was designed and manufactured by A.C.E. Machinery Limited, over twenty years ago . . . Today with the increasing trend toward multi-storey building structures, the ability to convey technicians and personnel to working levels speedily and safely, makes the employment of A.C.E. Passenger Hoists an economic necessity.

MK1 Ten men
MK2 Twenty men
Elevated at 230 ft/min.
Can be operated up to 600 ft.

A.C.E. Skymaster

PASSENGER HOIST

Write for complete specifications

A.C.E. MACHINERY LTD

BRIXTON, LONDON AND BRENTFORD, MIDDLESEX

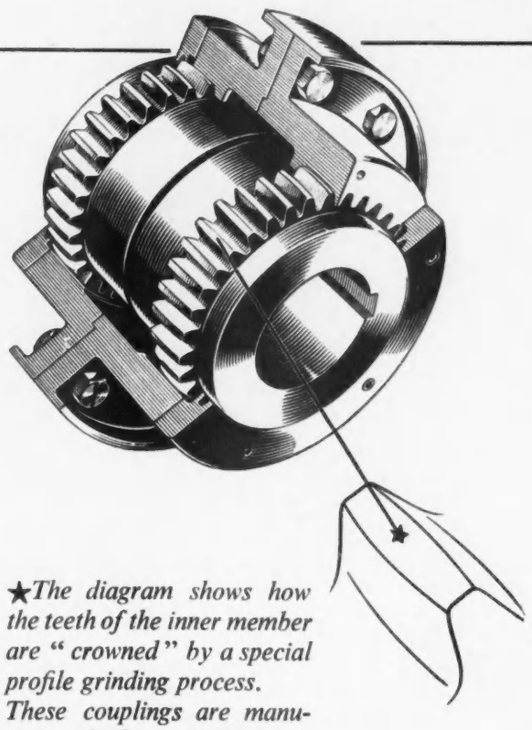
BRIxton 3293 (9 lines) EALing 6262 (5 lines) TELEGRAMS: AUSCON, TELEX, LONDON

ACE

ACE 79

Enter No. 1021 on reply card

a gear type coupling



★*The diagram shows how the teeth of the inner member are "crowned" by a special profile grinding process. These couplings are manufactured from high grade steel, in eleven standard sizes, and two types.*

In Wiseman gear type couplings provision is made for shaft misalignment. This means smoother running, less wear and correct tooth contact which in turn gives minimum backlash.

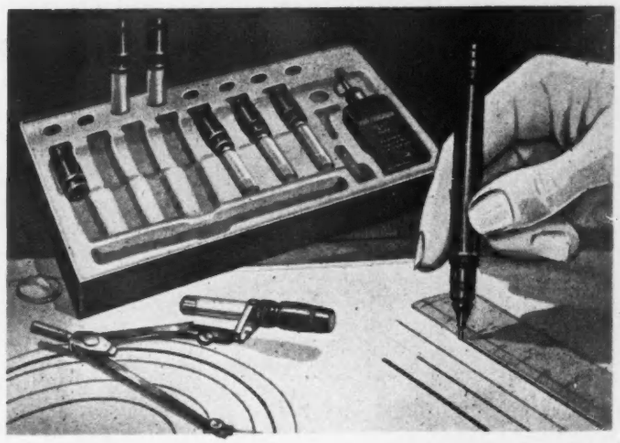
Write for descriptive leaflet.

WISEMAN

ALFRED WISEMAN & COMPANY LIMITED
Glover Street, Birmingham, 9 *Tel: VICTORIA 2216–7*

London Office: Carlisle House, Southampton Row, W.C.1
Tel: HOLBORN 7127

Enter No. 1031 on reply card



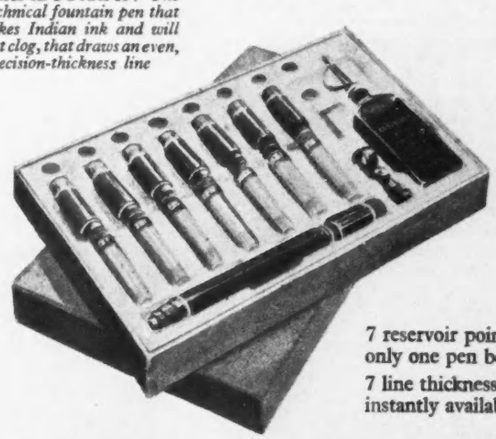
New, vital equipment for draughtsmen

the RAPIDOGRAPH* interchangeable

"VARIANT"

Now the world-famous Rapidograph technical fountain pen is available in this new *complete* form—seven line thicknesses in one set with a common pen-body—always ready for immediate use!
The "Variant" set is the most perfect drawing instrument of its kind ever made. Each point has a separate air-tight cap which not only prevents clogging but also enables size to be inter-changed without smudging the fingers or risk of damage to the points.
With special ink dispenser and compass attachment adaptor, the "VARIANT" is an invaluable item of equipment for every drawing office and studio.
Each point is colour-keyed for instant recognition, line thicknesses are graded between 0.2—1.2 mm in the most-used divisions.

**RAPIDOGRAPH! The technical fountain pen that takes Indian ink and will not clog, that draws an even, precision-thickness line*



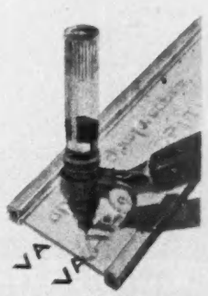
7 reservoir points - only one pen body!
7 line thicknesses - instantly available!

the RAPIDOGRAPH

"VARIOSCRIPT"

a special version for stencil-work

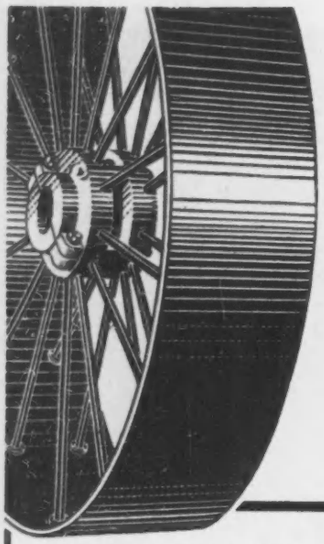
8 special flat Rapidograph lettering points and a common pen-body, together with an adjustable vertical attachment, go to make up this new stencil set. These points give perfect lettering in sizes from 2 to 10 mm.
RAPIDOGRAPH STENCILS–especially designed for the pens, these stencils are of first quality design and materials with metal edges to stand years of hard wear.



All items in the Rapidograph range may be purchased separately. Write for complete catalogue of Rapidograph precision drawing instruments or contact your usual drawing office supplier.

HARTLEY REECE & CO., LIMITED
34-36 CURSITOR STREET, LONDON. E.C.4

Enter No. 1032 on reply card



ALL SIZES - BUT ONLY
ONE QUALITY - *THE BEST!*

PULLEYS

BY

DOUGLAS, LAWSON
AND CO. LTD.

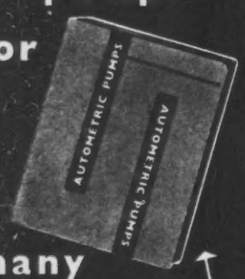
BIRSTALL · LEEDS · ENGLAND

Telephone : Batley 598 & 599
Telegrams : "Pulleys" Birstall, Leeds

• DOUGLAS, LAWSON PULLEYS
• "STANCHION" PULLEYS
• DESTRON SPLIT PULLEYS • STEEL ROAD WHEELS

Enter No. 1041 on reply card

AUTOMETRIC
pumps
for



many
purposes

CENTRIFUGAL
GEAR
TURBINE SINGLE & MULTI-STAGE
• MINI-GEAR
HAND ROTARY
OSCILLATING PISTON
ROLLER VANE
VACUUM
• DIAPHRAGM VACUUM
• H.P. 230 / 50 MOTORISED

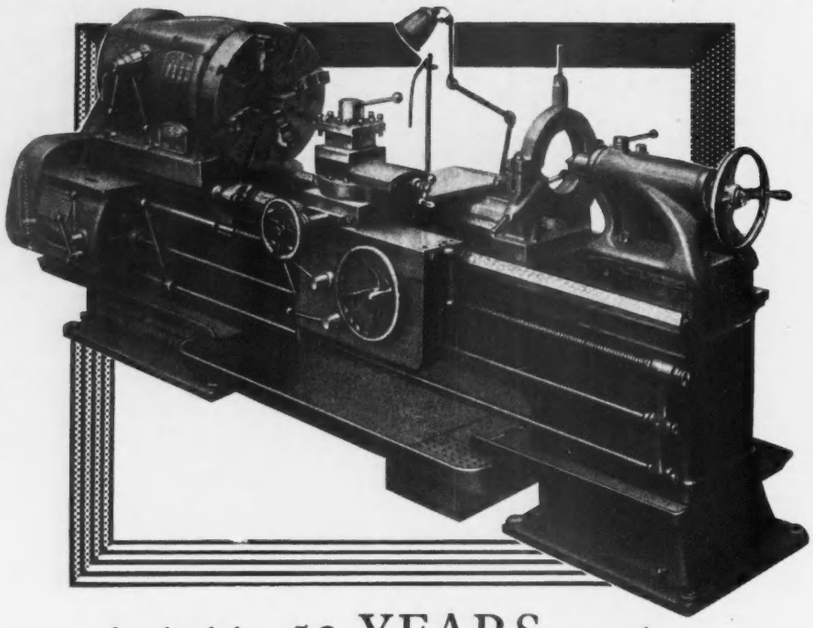
write for catalogue

AUTOMETRIC PUMPS LTD
LOWER WATERSIDE
MAIDSTONE · KENT
PHONE MAIDSTONE 4728

Enter No. 1042 on reply card

A thoroughbred – *the new*

Crowthorn 10½" (21" swing) H.D. Model Centre lathe



backed by 50 YEARS experience
in the manufacture of high class machine tools

Designed and built in the best traditions of Crowthorn quality and performance, the new 10½in. H.D. lathe is a worthy successor to the famous 10½in. M.D. Model. Notable entirely new features of the H.D. lathe are

- Larger hollow spindle, 3⅛in. bore
- Larger gap 36in. swing × 15¾in. width
- Completely redesigned bed
- Larger and more powerful headstock for heavier cuts and higher speeds
- Redesigned tailstock
- Electric suds pump

Please write for detailed literature on this outstanding new lathe.

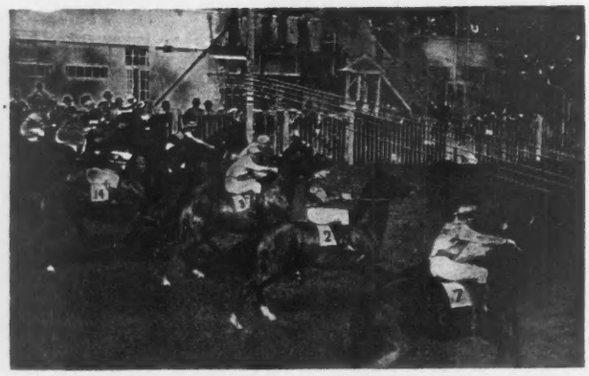
Other famous models in the Crowthorn range include Centre Lathes from 7½in. to 20in. centres, 30in. and 36in. swing Boring and Facing Lathes, with square or hexagon turrets, combination Turret Lathes and 19¼in. stroke Shaping Machines.

CROWTHORN
HIGH CLASS MACHINE TOOL MAKERS

CROWTHORN ENGINEERING COMPANY LIMITED
REDDISH - STOCKPORT - ENGLAND
Phone: STOCKPORT 7271-2-3 Grams: 'CROWTOOL, REDDISH'

CL 94

Enter No. 1043 on reply card



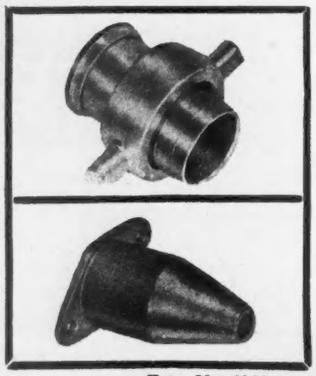
May we pick the winner for you . . .

When choosing between Die Castings or Hot Pressings you can count on us for sound, unbiased advice! We make both HOT PRESSINGS in *Brass, Bronze, Copper or Aluminium* and GRAVITY DIE CASTINGS in *Brass, Bronze or Aluminium*. The unique experience of our organisation . . . two separate yet inter-related operations under one roof . . . will ensure that your choice is correct. For a constant or phased supply of DIMENSIONALLY ACCURATE PARTS in *Brass, Bronze, Copper or Aluminium*—see us first! Our Technical Representatives are always at your service.

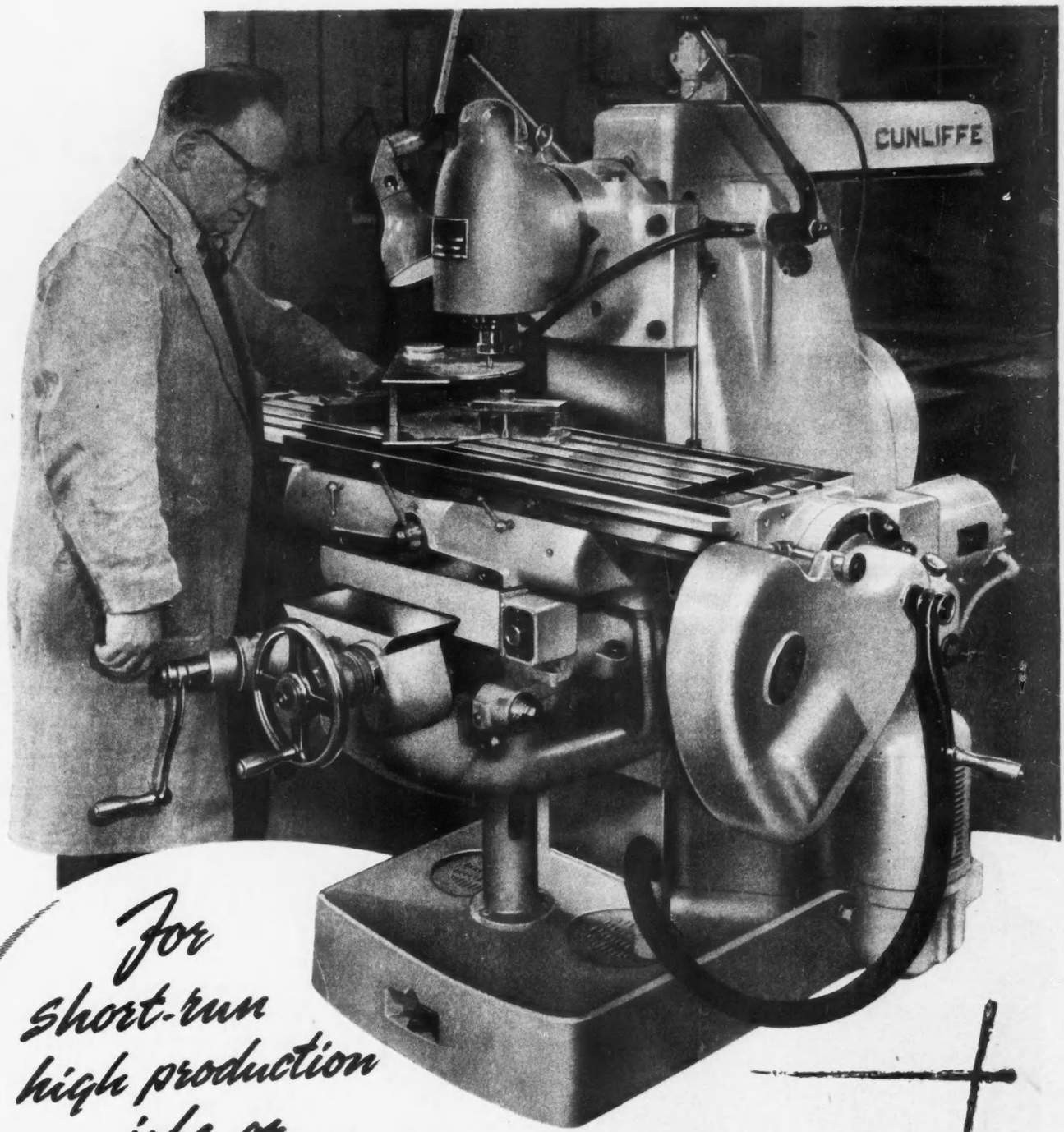
BRASS PRESSINGS (LONDON) LTD.
THE NON-FERROUS DIE CASTING CO. LTD.

Non-Ferrdies Works, North Circular Road, London, N.W.2 Tel : GLAdstone 6377 1732A

The choice is often difficult



Enter No. 1044 on reply card



For short-run high production jobs or - -

. . . . or for prototype work as shown, CUNLIFFE & CROOM horizontals, with their in-built features of precision and rigidity mean increased efficiency wherever they are installed. At the Imperial Tobacco Co., Ltd., Bristol, for instance, this machine, with vertical milling attachment, is fully employed in the Prototype Development Dept., on components for new machines.
CUNLIFFE & CROOM milling machines, horizontal, universal and vertical, are available in a range of sizes to reduce costs on your own work. Complete catalogues available. Write for your copies to-day.

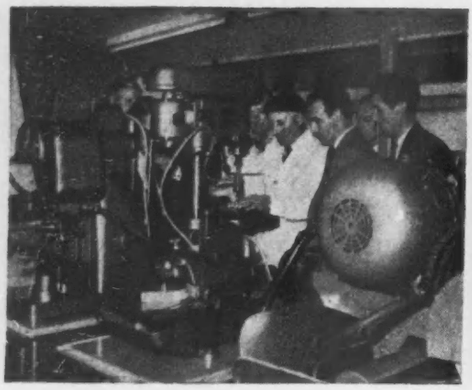
CUNLIFFE & CROOM
HORIZONTAL MILLERS

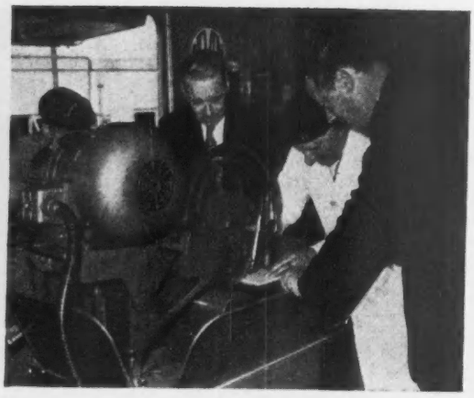
FULL PARTICULARS OF THESE MACHINES FROM

JAMES ARCHDALE & CO. LTD.

Registered Office: **LEDSAM STREET, BIRMINGHAM 16** *Tel. Edgbaston 2276 · Works:* **BLACKPOLE WORKS, WORCESTER** *Tel. Worcester 4355*
A MEMBER OF THE STAVELEY COAL & IRON CO. LTD. GROUP
Sole Selling Agents: **ALFRED HERBERT LTD., COVENTRY** *Tel. Coventry 89221*

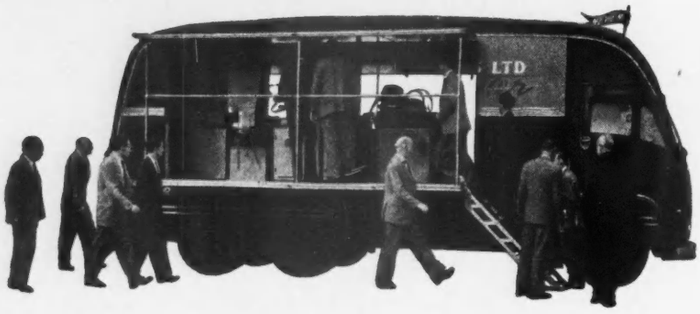
Enter No. 1051 on reply card





a DEMONSTRATION?

IF YOU CUT, drill or grind glass, ceramics, carbide or any known hard material the Neven Mobile Unit will demonstrate the most efficient production methods with diamond tools. May we send this Demonstration Unit to your works? The Sales Manager would be pleased to advise you when the Unit will be in your area.



IDP

IMPREGNATED DIAMOND PRODUCTS LIMITED
OF GLOUCESTER · ENGLAND
TELEPHONE 21164 (3 LINES) TELEGRAMS IMPREG GLOUCESTER

Enter No. 1061 on reply card

A COMPLETE RANGE OF

'Micronic' OIL FILTERS

Purolator Micronic oil filters provide complete protection for your engine. By removing even the smallest particles of harmful dirt, they drastically reduce the rate of engine wear.

The construction of the 'Micronic' element ensures that the largest possible filtering area is packed into the available space, thus providing longer life.

A relief valve allows the oil to continue flowing if the element is allowed to become completely choked.

Both external pipe and direct pad mounting types (as illustrated) are available for all sizes of engine.

AUTOMOTIVE PRODUCTS COMPANY LIMITED
LEAMINGTON SPA,
WARWICKSHIRE

One of the Automotive Products Group

Regd. Trade Marks:
'PUROLATOR'
'MICRONIC'

PUROLATOR

Enter No. 1062 on reply card

One man and one hundred nuts

How long should it take him to fix them?

According to accepted engineering practice* it would take a worker as long as 197 minutes to assemble 100 5/16″ slotted nuts and split pins. . Yet the same man would take a bare 40 minutes to assemble an identical number of Simmonds 5/16″ **Nyloc** self-locking nuts.

Common sense says that it pays to use Simmonds self-locking nuts every time when assembly costs run as high as they do today. In fact, with average labour costs and overheads, there are savings of over 42/– on every hundred assemblies—and over £2,000 on every hundred thousand assemblies. Why not call in Simmonds to carry out a completely thorough costing of *your* assembly operations.

Our 16 mm Nyloc colour film is available free of charge from the Central Film Library, for showing in your factory.

* *All times are based on the Haddon & Genger Standard Data (1955) Handbook. Costs include wages at 5/- an hour and overheads at 250%.*

time saved is money saved **SIMMONDS SELF-LOCKING NUTS**

SIMMONDS AEROCESSORIES LTD · TREFOREST · PONTYPRIDD · GLAMORGAN

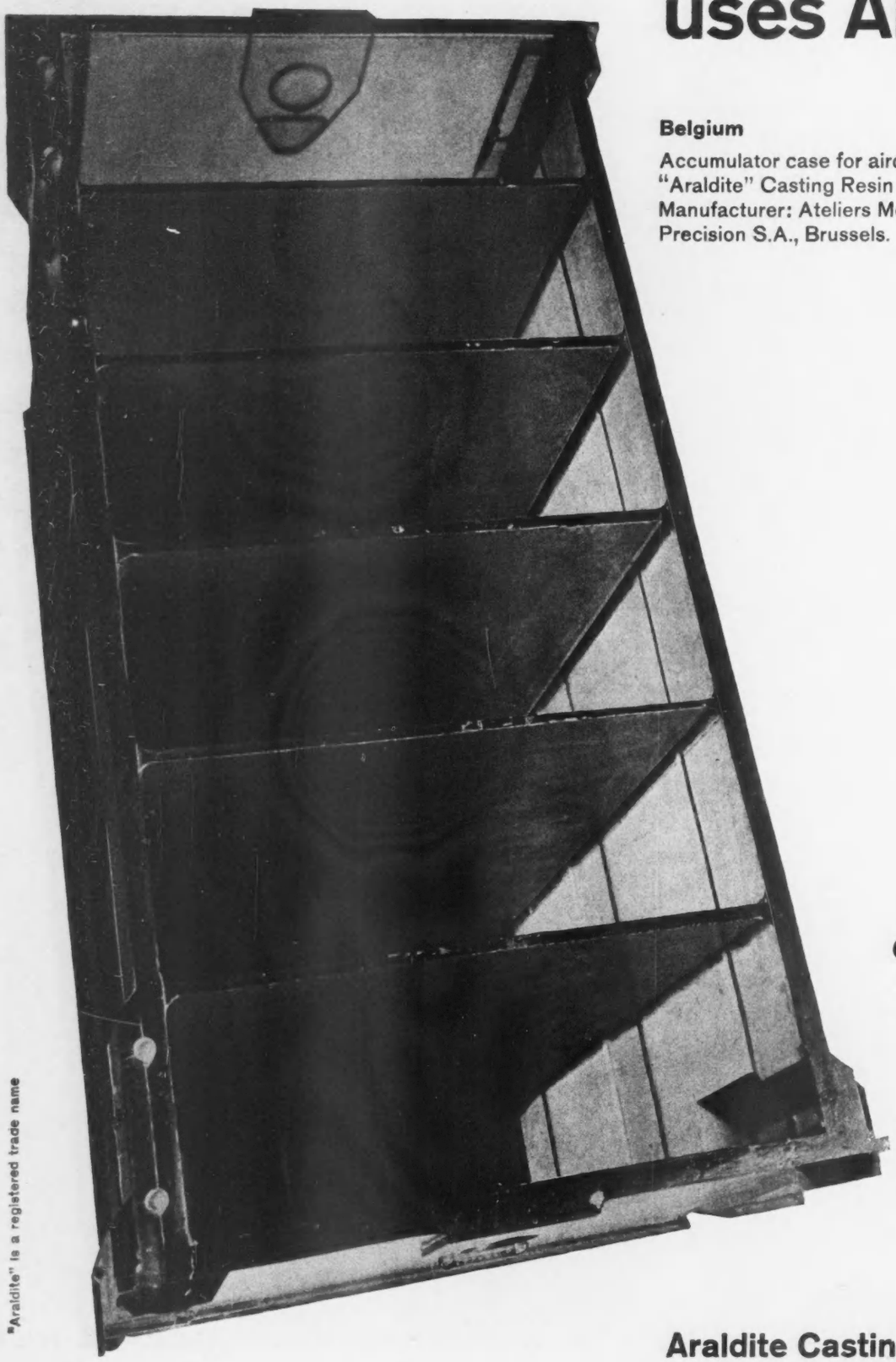
FC *A member of the Firth Cleveland Group*

Branches: London, Birmingham, Manchester, Glasgow, Stockholm, Copenhagen, Ballarat, Sydney, Johannesburg, Amsterdam, Milan, New York, Mannheim and Brussels

CEC 43N

Enter No. 1071 on reply card

The World uses Araldite



Belgium

Accumulator case for aircraft, made from "Araldite" Casting Resin B.
Manufacturer: Ateliers Mecaniques de Precision S.A., Brussels.

CIBA

"Araldite" is a registered trade name

CIBA (A.R.L.) LIMITED

Duxford, Cambridge. Telephone: Sawston 2121

Araldite Casting Resins
Araldite Coating Resins
Araldite Laminating Resins
Araldite Adhesives

Enter No. 1081 on reply card

Tests prove

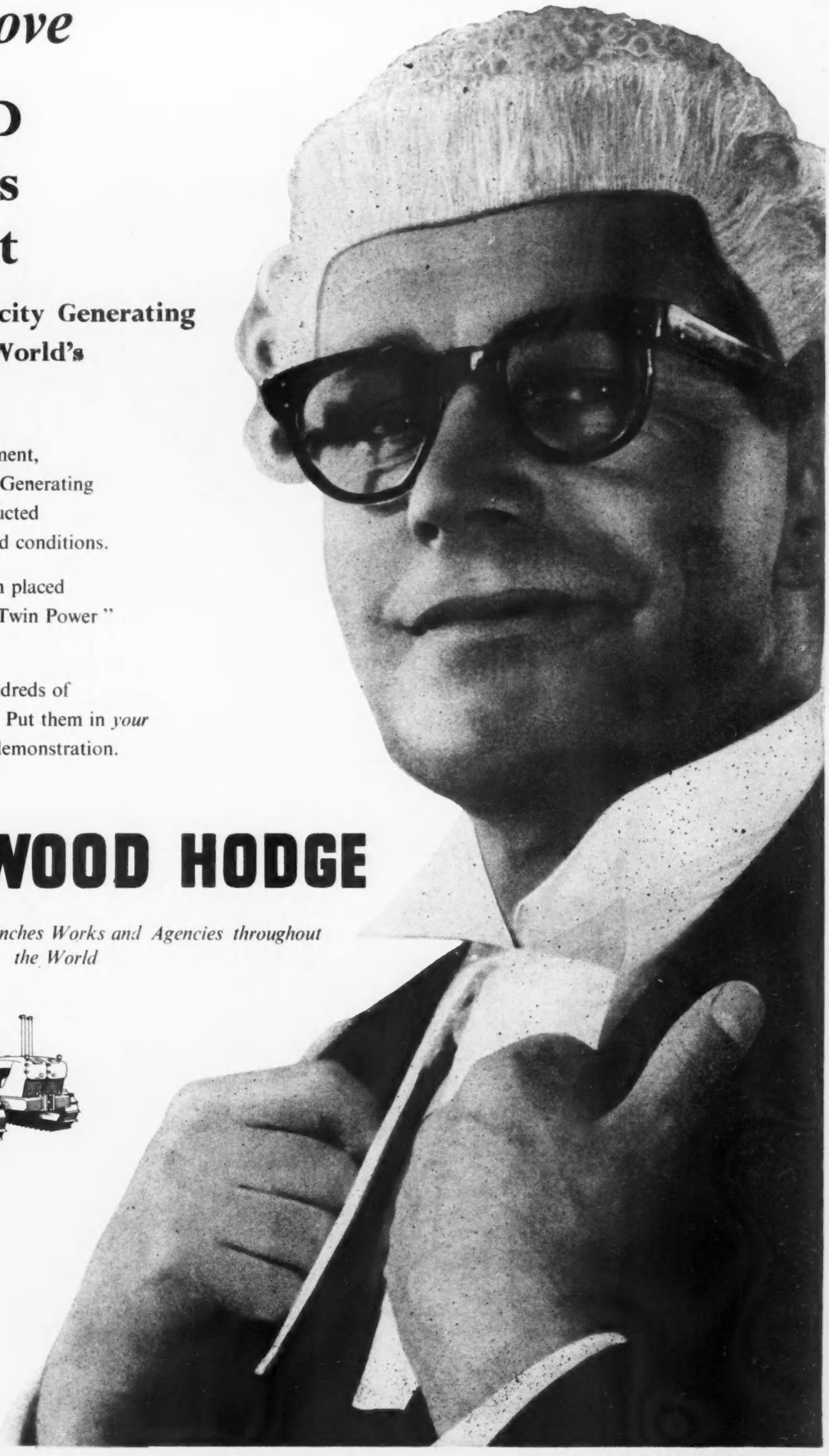
EUCLID TC - 12's are best

Central Electricity Generating Board orders World's best Crawlers

Before selecting equipment, the Central Electricity Generating Board held trials conducted under strictly controlled conditions.

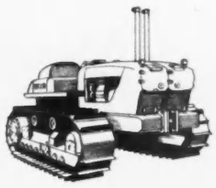
An order has now been placed for EUCLID TC-12 " Twin Power " Crawler Tractors.

TC-12's are saving hundreds of thousands of pounds. Put them in *your* fleet. Ask *now* for a demonstration.

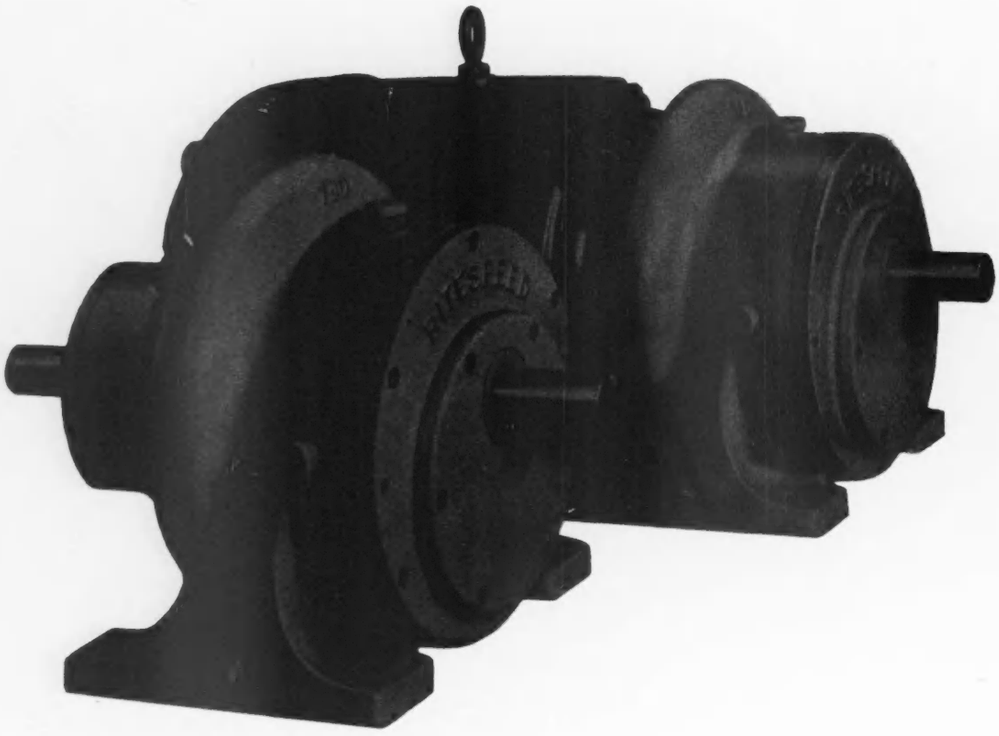


BLACKWOOD HODGE

Subsidiary Companies Branches Works and Agencies throughout the World



Enter No. 1091 on reply card



Wherever power is used Crofts Gearboxes play a vital role . . .

Crofts (Engineers) Limited, Thornbury, Bradford 3, Yorkshire

Crofts Ritespeed Geared Motors & Reduction Gears

FRACTIONAL TO 80H.P : RATIOS UP TO 82:1

Geared motors up to 20 h.p. supplied from stock—'phone Ext. 34

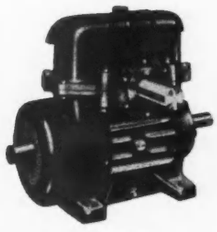
★ standard units (left) ideal for floor, wall, ceiling and vertical mounting

★ flange-mounting, universal and co-axial output vertical units also available

★ Hiratio adaptors provide ratios up to 2175 : 1

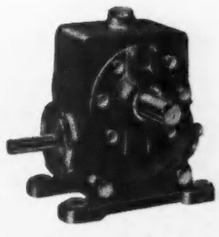
Publication 5329 & 5737

Shaft Mounted Gear Units
Publication 157/A



4" 6" & 8" Worm Gears to EEUA Standard Dimensions
Publication 5743

Multispeed 2, 3, & 4 Speed Reduction Gears
Publication 592



Universal Mounting Worm Reduction Gears
Publication 571

CROFTS (ENGINEERS) LIMITED

POWER TRANSMISSION ENGINEERS

Head Office - Thornbury - Bradford 3 - Yorkshire

Telephone : 65251 (20 lines) Telegrams : "Crofters Bradford Telex" Telex 51186

Makers of :

Clutches, Conveyor drives, Couplings of all types, Double helical gear units, Fabricated steelwork, Geared motors, Hydraulic couplings, Iron, steel and non-ferrous castings, Machine-cut gears of all types, Motorised rollers, Patent Taper-Flushbushes, Plummer blocks, Shaft-mounted gear units, Special machinery drives, Spiral bevel gear units, Turbine gears, V-rope Drives, Variable-speed drives, Worm reduction gears.

Branches at : Belfast, Birmingham, Bristol, Cardiff, Dublin, Glasgow, Ipswich, Leeds, Liverpool, London, Manchester, Newcastle, Northampton, Nottingham, Sheffield, Stoke-on-Trent.

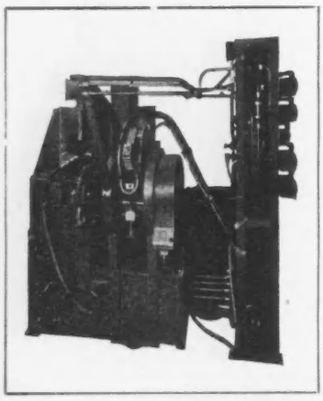
SUBSIDIARY COMPANIES IN CANADA, SOUTH AFRICA, U.S.A. WORLD-WIDE REPRESENTATION

Enter No. 1111 on reply card

Are you keeping your fingers crossed?

. . . and hoping that your machinery problems will work themselves out!

A far better way would be to '*talk it over with* DATIM' — for, with our long experience in Automatic machine building, we can offer an unequalled service — working to customers' own designs or providing complete design and development service in co-operation with customers engineers.



- ★ Rotary and Straight Line Transfer Machines for multiple machining operations
- ★ Automatic selective hopper fed assembly machines.
- ★ Automatic tube bending machines.
- ★ Rubber manipulating machines.
- ★ Automatic Bar turning machines.

DATIM

Manufacturers of Special purpose precision machinery

DATIM MACHINE TOOL CO. LTD.

Billet Road, Walthamstow, London, E.17. Telephone : Larkswood 2313 (3 lines)

Works : Brooker Road, Waltham Abbey, Essex.

A MEMBER OF DAVIS & TIMMINS LTD., GROUP OF COMPANIES

Enter No. 1121 on reply card

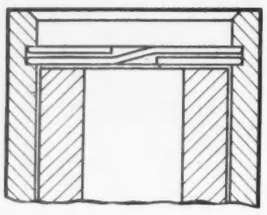
SPIROLOX

The retaining ring that really locks!

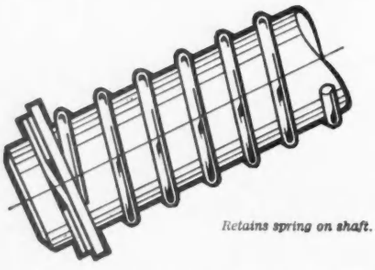
Wellworthy SPIROLOX Retaining Rings consist of two turns of flat spring steel strip formed in a continuous helix. They are concentric, with no projecting ears or lugs, and may be fitted and removed without the need for circlip pliers or other special tools. Spirolox Rings remain firm in the groove when subjected to end thrust.

Spirolox Rings are light in weight and their full circularity ensures even circumferential pressure. They are well engineered, their symmetrical design ensures excellent dynamic balance for high speed shafts.

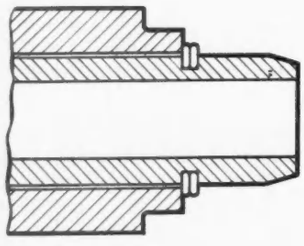
Most protective treatments can be applied to SPIROLOX Rings, including phosphate and cadmium, or they can be supplied in stainless steel.



2½" internal Spirolox used to limit travel of sleeve in hydraulic ram, thrust 16,300 lbs.



Retains spring on shaft.



1¼" external Spirolox for locating end movement on shaft.

WELLWORTHY
'THE CHOICE OF THE EXPERT'

Spirolox Retaining Rings

Manufactured under licence from the Ramsey Corporation, U.S.A.

Write now for full particulars and samples to Dept. EN10, Lymington, Hants

Enter No. 1122 on reply card

N.C.B. MINE CAR CIRCULATION LAYOUT By SUMMERSONS

This indoor Mine Car layout at a Scottish Colliery is an example of the versatility of Summersons designing and manufacturing resources. Laid on a stepped concrete floor, the 3ft. 0in. gauge 50 lb. F.B. Rail Tracks are fastened to transverse steel channel sleepers bolted to longitudinal steel joists or plate girders, by which means the appropriate gradients are obtained. Cars are gravity operated and the switches electrically controlled from a central panel.

Main Contractors : Markham & Co., Ltd., Chesterfield.

THOS. SUMMERSON & SONS LTD.
Mowden Hall, Darlington.
Telephone Darlington 5226
London Office : 5a Deans Yard, S.W.1.
Telephone ABBey 1365

Enter No. 1131 on reply card

One minute of your precious time—

that's all it will take to fill in the coupon below. It will introduce you to valuable time-savings in production and finishing methods from the use of E.A.C. 'shaped-grain' flexible abrasives. These coated abrasives, made by the latest controlled automation techniques, incorporate every worthwhile advance in design and manufacture. In the wide range of E.A.C. belts, discs, sheets and special shapes there is sure to be, for any operation, one that cuts faster and wears longer than those you are now using.

The right abrasive can save you money, let *us* find it for you; send now for samples, specifications, prices of the best abrasive for any operation in your industry.

Please send your catalogue and price list of Metalworking coated abrasive materials to:

NAME .....

COMPANY .....

ADDRESS .....

.....

.....

A4/9

change now . . . to

EAC LIMITED

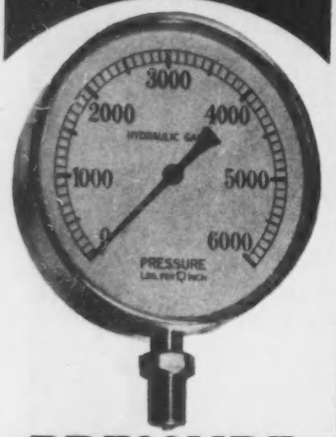
coated abrasives

ENGLISH ABRASIVES CORPORATION LTD
Marsh Lane, Tottenham, London N.17 Tel: Tottenham 3057
SUBSIDIARIES: Thos. Goldsworthy & Sons Ltd
The Helvetia Abrasive Co. Ltd
London Abrasives Ltd

D.1557

Enter No. 1132 on reply card

To gauge your requirements

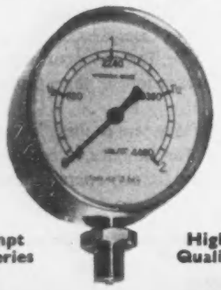


PRESSURE

GAUGES

OF EVERY DESCRIPTION & SIZE

Pressure range from 5-20,000 lbs. per sq. inch.



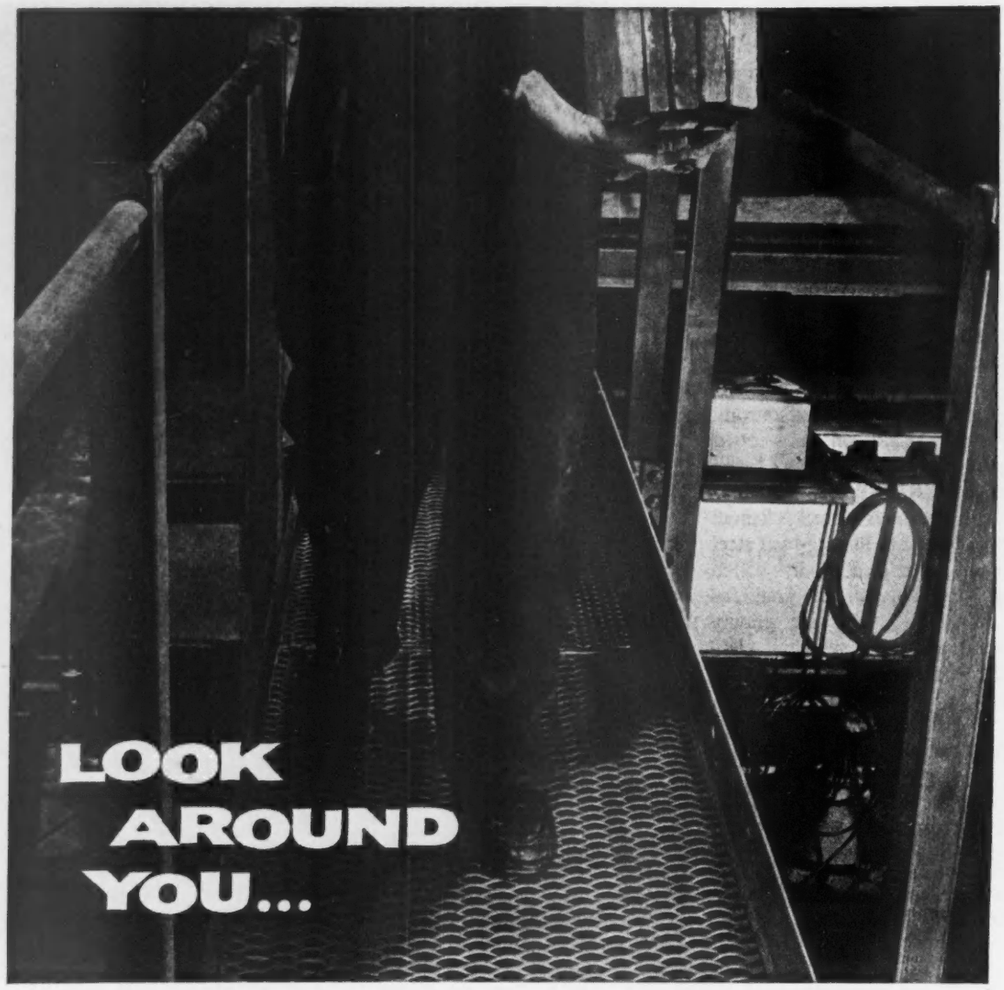
Prompt Deliveries **Highest Quality**

Send for illustrated Catalogue

EAGLE & WRIGHTS (GAUGES) LTD.

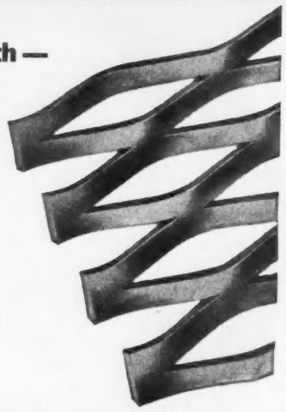
87 CARVER STREET
BIRMINGHAM, 1
Telephone: Central 8196

Enter No. 1141 on reply card



at Expanded Metal Walkways — massive strength — maximum safety — extreme adaptability

Look around you and you'll see how Expanded Metal Walkways, stair treads and floor panels can benefit you. Lighter and less expensive, Expanded Metal allows the passage of more light and air. Furthermore the angled strands cannot harbour underfoot the oil and grease that cause so many stair and walkway accidents. Not only is Expanded Metal Walkway immensely strong and safe—it feels safe too. In sheet steel or non-corrosive light weight aluminium, Expanded Metal can either be engineered to measure or supplied in standard size sheets.



EXPANDED METAL

at the heart of more things than most people realise

THE EXPANDED METAL CO. LTD. BURWOOD HOUSE, CAXTON ST., LONDON, S.W.1. TELEPHONE: ABBEY 7766
ALSO AT: ABERDEEN · BELFAST · BIRMINGHAM · CARDIFF · DUBLIN · EXETER · GLASGOW · LEEDS · MANCHESTER · WEST HARTLEPOOL · THE EXPANDED METAL COMPANY OF CANADA LIMITED, ANNACIS INDUSTRIAL ESTATE, VANCOUVER, CANADA

Expamet

Enter No. 1142 on reply card

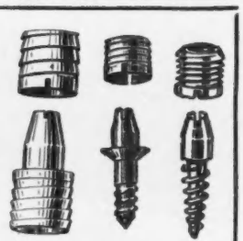
EVERYTHING FOR THE PATTERN SHOP

MALL IRON
DOWEL PLATES
DOWELS FOR
METAL PATTERNS

FILLETS
"PLASTIFIL"
"POLYFIL"
LEATHER FILLET

LETTERS
ALL SIZES AND STYLES

B



BRASS
DOWELS AND
SOCKETS

J.W. & C.J. PHILLIPS LTD.,
POMEROY ST., NEW CROSS, LONDON, S.E.14

Enter No. 1143 on reply card

CABLE DRAG CHAINS

all over the world for . . .

**Machine Tools,
Cranes,
Welding Machines,
Loading Bridges,
Forging Machines,
Rolling Trains,
Fork Lift Trucks,
Power Presses, etc.**

**reliable —
accident - proof —
space-saving**

Sole Agents for British Isles :—

E. M. SENIOR

**BOURTON,
Nr. RUGBY.**

Tel.. Marton 276.

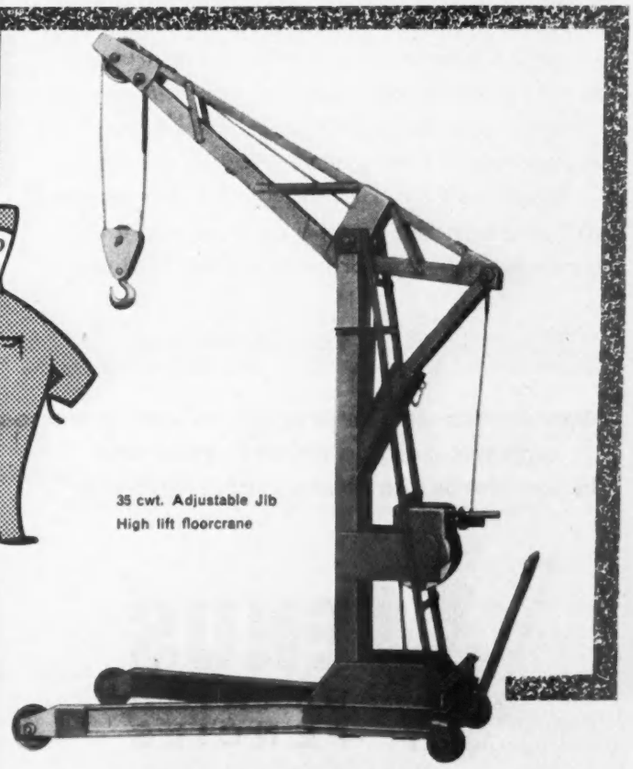
KABELSCHLEPP
G M B H
SIEGEN / WESTFALEN
Hagener Straße 61 · Postfach 384 · Ruf 22248/49

Enter No. 1151 on reply card

LET *ME* GIVE YOU A LIFT!

Make it easy on yourselves . . . Plant Maintenance we mean. When it comes to hefting plant about, resiting or rebedding machinery, or any one of the 101 jobs that crop up in any maintenance shop, then you need ME lifting equipment to take the strain. There's a wide range of cranes and gantries to choose from, with lifting capacities from 5—40 cwt. according to the model. Prices? No more than you would expect to pay for worthwhile equipment.

✻ *WHY NOT WRITE FOR OUR CATALOGUE OF LIFTING GEAR?*



35 cwt. Adjustable Jib
High lift floorcrane

MANN EGERTON & CO LTD

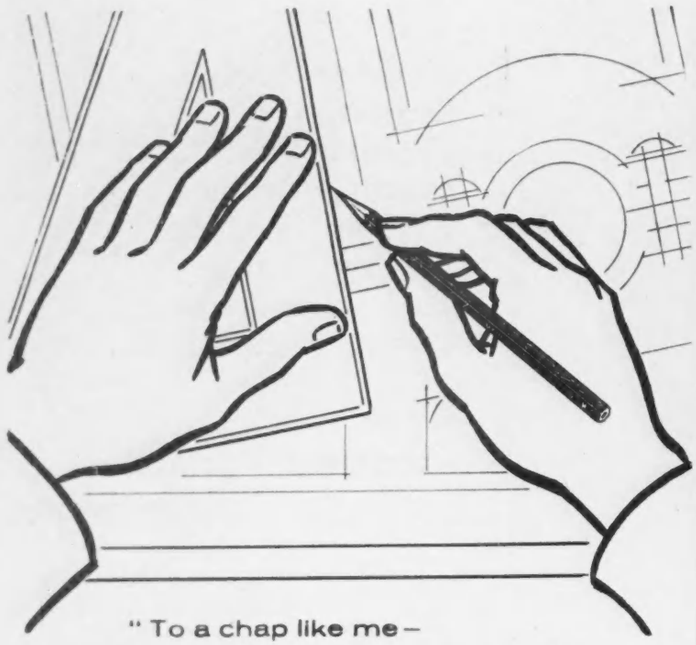
**MAKE VERY GOOD
HAND-OPERATED CRANES
GANTRIES AND PRESSES**

Cromer Road Works · Norwich Tel: 47272

ME EQUIPMENT INCLUDES

Cranes, Gantries, Cleansing tanks,
Recovery equipment, Tyre remover,
Miscellaneous workshop equipment.

Enter No. 1152 on reply card



"To a chap like me –
and I'm proud of my work – my pencil's
my living.
The pencils I use have to stand up to fast
hard work, their grading's got to
be absolutely spot on – not almost
or nearly but bang on the dot every
time.
The leads must hold their points
and flow smoothly throughout a long line –
no crumbling or 'clinkers' mark you! –
and if I erase a line it must go cleanly –
there's no 'furrow' left in my paper
so you won't find ghost lines in prints
made off my drawings. As a matter of
fact you can tell from a print when it is
my drawing – the print's always first class".

"What pencils do I use?"

"Venus drawing pencils of course, the ones
with the crackle finish! – how else
do you think I keep my high standard?"

VENUS
DRAWING
PENCILS

* VENUS *Drawing Pencils are made in 17 accurate grades from 9H to 6B.*

THE VENUS PENCIL CO., LTD., LOWER CLAPTON ROAD, LONDON, E.5.

Enter No. 1161 on reply card

quality malleable castings B·S·S309
EASILY MACHINEABLE
also
SOFT GREY IRON CASTINGS
for all trades

REGD. TRADE MARK

alfred.h
MOULD
& SONS LIMITED

Our metal is melted under strict metallurgical control in modern Rotary Furnaces and is annealed in up-to-date pulverised coal furnaces ensuring perfect dependability.

STAFFORD STREET · WALSALL · TEL: 3509

SOUTHERN REPRESENTATIVE:
G. P. SANDERSON, LTD.
SANDERSON HOUSE, NORFOLK SQ.
BRIGHTON 1.
PHONE: HOVE 71329.

LANCS, YORKS, CHESHIRE, SHROPSHIRE REPRESENTATIVE:
MALCOLM P. ROWE,
PRUDENTIAL BUILDINGS, ST. PETERSGATE, STOCKPORT, CHESHIRE.
PHONE: STOCKPORT 5512.

Enter No. 1162 on reply card

10 ton Steam Permanent Way Crane. Metre Gauge. Duty: 10 tons at 16 ft. radius propped; 5 tons at 14 ft. radius free

3 Motor, electrically operated Fixed Wharf Crane. Duty: 15 tons at 22 ft. radius.

T&H

CRANES

STEAM
DIESEL
DIESEL-ELECTRIC
ELECTRIC

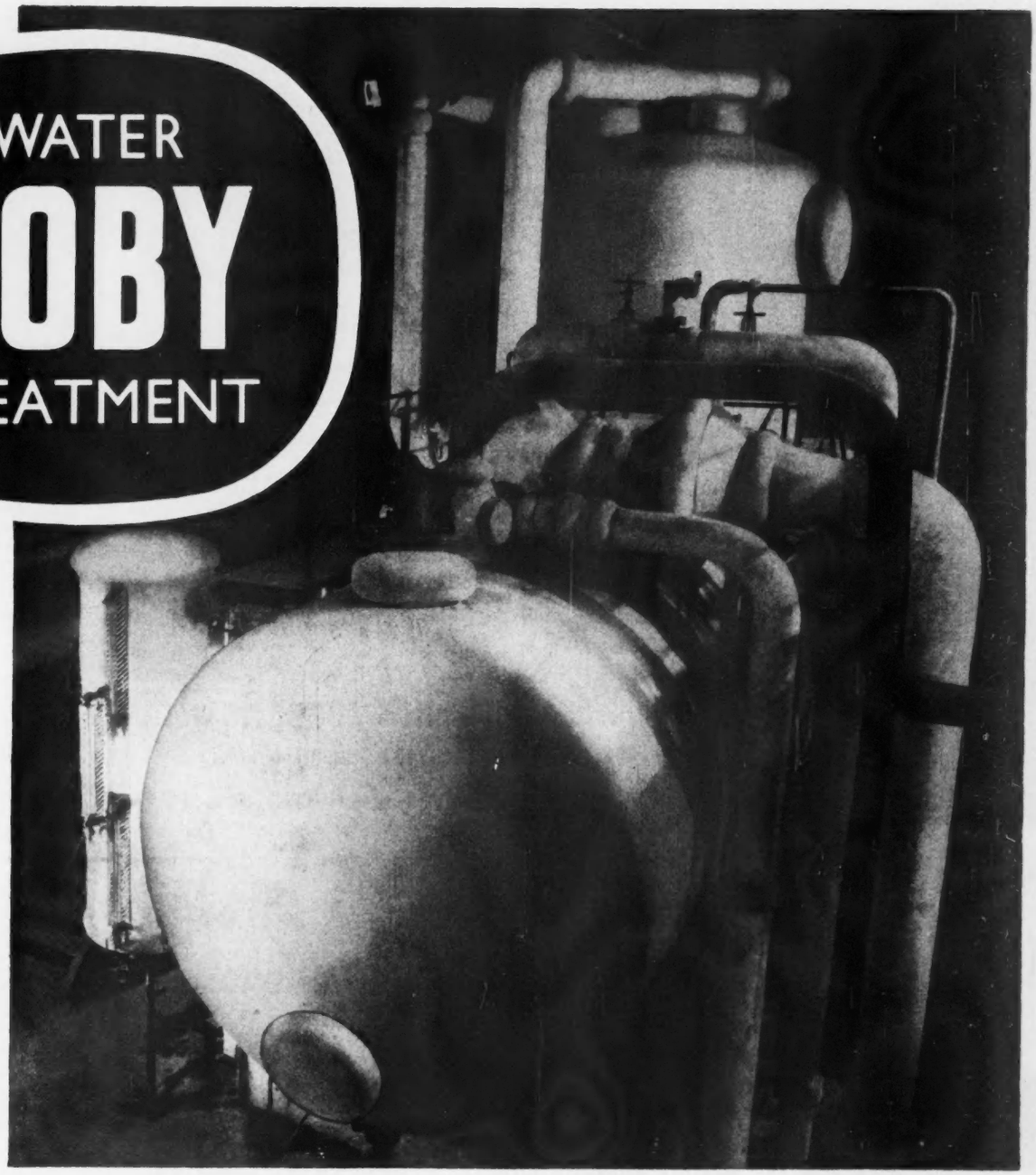
KENT STREET
TAYLOR & HUBBARD
LTD
LEICESTER

Telegraphic Address: "Lifting, Leicester"
Telephone Nos.: 22571-6

Enter No. 1163 on reply card

WATER BOBY TREATMENT

Established 1875



Deaeration. A 'Boby' Deaerator has been installed, or is being installed, as part of the feed heating system of each of Messrs. C. A. Parsons & Co's turbo-generating sets in the following modern power stations :—

Central Electricity Generating Board's Power Stations in England and Wales

2 — 60 MW sets at Rogerstone
2 — 60 MW sets at Little Barford
4 — 120 MW sets at Drakelow 'B'
6 — 100 MW sets at Aberthaw
1 — 550 MW set at Thorpe Marsh

S.S.E.B. Power Stations in Scotland

2 — 60 MW sets at Dalmarnock

Power Stations Abroad

3 — 60 MW sets at Lake Macquarie, Australia
2 — 66 MW sets at Boundary Dam, Canada
2 — 66 MW sets at Selkirk, Canada
1 — 15 MW set at Hunts Bay, Jamaica
2 — 25 MW sets at Monterey, Mexico

One of the two 'Boby' deaerators and feed tanks installed at the Central Electricity Generating Board's ROGERSTONE Power Station, South Wales. Capacity 520,000 p.p.h. Deaerated water.

All these 'Boby' Deaerators are fitted with the special 'Boby' weight loaded deaerating nozzles, deaerating trays, flash suppressor device and all necessary steam pressure and water level controls to ensure a continuous supply of deaerated water to the boiler feed pumps under all load conditions. The guaranteed maximum residual is, in most cases, 0.005 c.c./litre.

William Boby & Co. Ltd. RICKMANSWORTH, HERTFORDSHIRE, ENGLAND. Tel: Rickmansworth 4251*

Enter No. 1171 on reply card

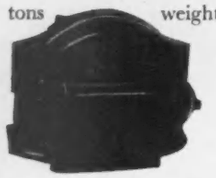
QUALITY CASTINGS

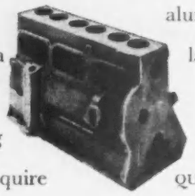
FOR QUANTITY SUPPLY...
in Iron or Aluminium Alloy

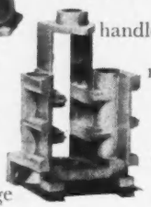
TO MANY INDUSTRIES

Vehicle Building
Car Manufacture
Aircraft Manufacture
Coal Mining
Machine Tools
Chemical Plant
Railway Plant
Electrical Appliances
Diesel Engines
Shipbuilding
Refrigeration
Domestic Appliances
Textile Machinery
Printing Machinery
Industrial Trucks
Fans, etc., etc.

CAST WELL AND TRUE







Quality castings in grey iron, aluminium alloys and Mazak are supplied in large quantities for a wide range of industries, including the major part of the British motor industry. Our iron foundry has five fully mechanised units designed to handle varying weights and sizes in order to provide maximum economies in mass production. A large floor-moulding section can handle castings up to 5 tons weight. The aluminium foundries produce a large tonnage by sand casting, gravity die casting and pressure die casting to meet exacting conditions of service. Call us in the next time you require QUALITY castings for quantity supply...

West Yorkshire Foundries Ltd.

Sayner Lane · Leeds 10 · Telephone: Leeds 29466
LONDON OFFICE:
Hanover House · Hanover Square · W1 · Telephone: MAYfair 8561

Enter No. 1181 on reply card

Wire (Stainless) . . .

KNITTERS for the use of

As Manufacturers of Austenitic Stainless Steel Wire, we can cover all your requirements to DTD, BS, AISI, etc., specifications.

These specifications include DTD 189, DTD 489, DTD 549, DTD 571, DTD 734, DTD 2002, etc.

•

BS 2056, BS 1554, BS 1453, W10, W11, E20, etc.

•

AISI 302, AISI 304, AISI 316, AISI 321, AISI 347, etc.

or to your own specifications.
AID and ARB approved.

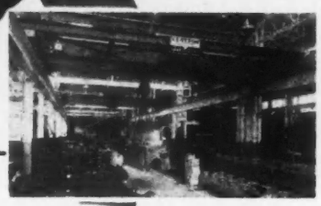
We have watched with wonder at Granny's knee, the speed and deftness with which our school stockings materialised from her clicking needles before our very eyes. Commercially minded customers of ours carry out similar operations with our famous AUSTENITIC STAINLESS STEEL WIRE at fantastically greater speeds. This is partly achieved, in no small measure we are told, by the assistance lent to their operations by our excellent product. In depicting the Wire Knitters Training School above (class of 1959), our fancy has run as freely as the wire we make. Though the method may be archaic, the principle remains that, whatever shape, size, knit or purl you require, the very best is available from us, and at prices which deserve to be increased beyond those prevalent, but for you, we will charge no more. Such generosity deserves, at least, your kind enquiry

STAINLESS STEEL WIRE CO. LIMITED

THE BARRACKS · LANGSETT ROAD · SHEFFIELD, 6
Telephone: SHEFFIELD 344241 *Telegrams:* FINEWYRE SHEFFIELD

Enter No. 1182 on reply card

I don't give a WHO buys 'em!



Two of eight 5-tons short headroom double girder cranes with micro-hoisting.

SOME CLAYTON CRANE BUYERS admit to having been impressed by long lists of "famous users", while others flatly refute any suggestion that big names have influenced their choice. All unanimously agree however, that their Clayton cranes are putting up a first-class, reliable and easy-to-maintain performance.

From our comprehensive range of manufactures we are well equipped to solve many handling problems by the use of standardised stock assemblies. Should your problem be unusual and need a "tailor-made unit", specially designed to fit the situation, then the wide experience of the Clayton organisation is at your disposal. Our technical representatives, operating throughout the British Isles and most countries abroad, are at your service.

● ASK FOR CATALOGUES

CLAYTON overhead cranes

REGISTERED TRADE MARK

THE CLAYTON CRANE & HOIST CO. LTD. (DEPT 33) . IRWELL CHAMBERS EAST . UNION STREET LIVERPOOL 3

Phone: CENtral 1141 (4 lines) . Grams: Claymag, Liverpool . London Office: 12 Duke Street St. James's, S.W.1 . Phone: WHItehall 6988

Enter No. 1191 on reply card

MARLCo

KEYWAY BROACHES

Cut perfect taper or parallel Keyways with any type of hand press, without skilled labour or elaborate set up.

No. 0 SET for $\frac{1}{32}$"-$\frac{1}{4}$", with guide diameters $\frac{1}{4}$"-$\frac{1}{2}$".
No. 1 SET for $\frac{1}{4}$"-$\frac{1}{16}$", with guide diameters $\frac{1}{2}$"-1$\frac{1}{2}$".
No. 2 SET for $\frac{1}{16}$"-$\frac{3}{16}$", with guide diameters 1$\frac{1}{2}$"-2".
No. 3 SET for $\frac{3}{16}$"-$\frac{1}{2}$", with guide diameters 2"-3$\frac{1}{4}$".

Broaches and guides are interchangeable for non-standard Keyways within their respective sets.

Standard Square Broaches $\frac{1}{16}$"-$\frac{1}{2}$" also available.
Send for details to:

CUT COSTS IN KEYWAYS

W. H. MARLEY & CO. LIMITED
NEW SOUTHGATE WORKS, 105 HIGH RD., LONDON, N.11
TELEPHONE: ENTerprise 5234, 5578

Enter No. 1192 on reply card

SPURS
BEVELS
WORM WHEELS
HELICALS
CHAIN GEARS

Complete Supply
Cutting Only

Machine Cut Gears

WORMS
RACKS
SCREWS
SILENT GEARS
CHANGE GEARS

All materials standard pitches to 7ft diameter

General machine castings made to customers' patterns. Low prices for planing, boring, turning, screwcutting
Send your enquiries to

GREENWOOD'S STANDARD GEAR CUTTING CO. LTD.,
New Bond Street, Halifax. *Telephone: Halifax 5217/8* *Telegrams: "Gears."*

Enter No. 1193 on reply card

KnitMesh

A NEW RAW MATERIAL

KnitMesh is a mesh structure of asymmetrical interlocking loops, knitted from metals or plastics.
KnitMesh is made in many combinations of interstice size, wire diameters and materials.
The basic mesh can be crimped or folded in a variety of pitches, depths and patterns, which can be used, open or compressed into suitable sizes and shapes.
A wide range of unusual combinations of properties—physical, chemical and electrical—can therefore be achieved.

HERE ARE FOUR EXAMPLES OF THE MANY WAYS IN WHICH KNITMESH IS NOW BEING USED.

KnitMesh
Demisters and Separators.

KnitMesh enables a high percentage of free volume to be obtained in combination with a large surface area.
Removal efficiency is 99 to 100 per cent.

KnitMesh
Electronic R.F. Shields.

The compressibility and resilience of KnitMesh weather-strips, gaskets and spindle glands ensure good contact even when there are surface inequalities. No special machining is therefore required for a perfect shield.

KnitMesh
Valve Jackets.

The combination of large surface area and resiliency produces a valve jacket which protects against vibration and has excellent heat exchange properties.
It also acts as an R.F. Shield.

KnitMesh
Air Intake Filters.

Whether compressed or open, KnitMesh provides an even density with an even calculable performance.
Because of the resiliency of KnitMesh filters, they can be made to fit a container of any shape.

KnitMesh has great possibilities. We will gladly co-operate in the development of new applications.

KnitMesh LIMITED

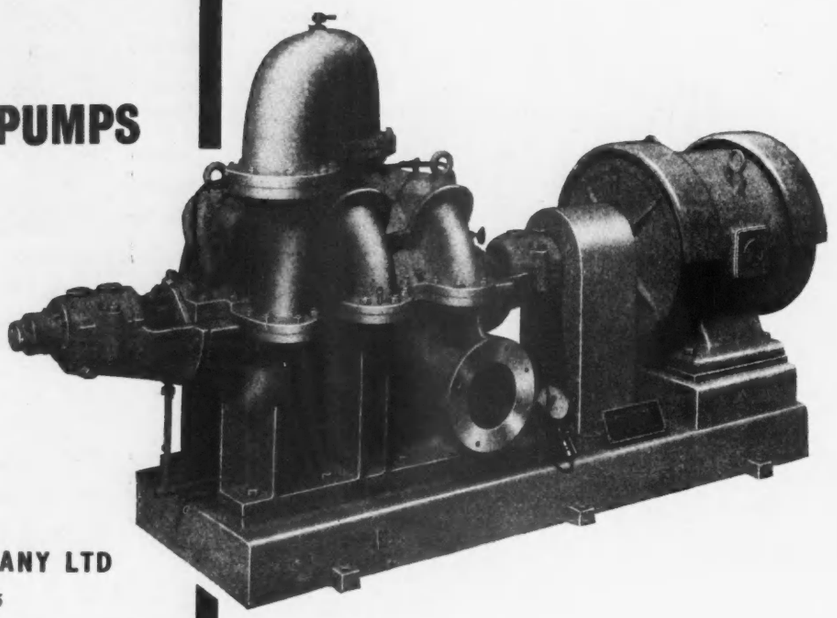
36, VICTORIA STREET, LONDON, S.W.1. Tel: ABBey 2684

Enter No. 1194 on reply card

Mirrlees'

CONDENSATE PUMPS

Three Stage Condensate
Extraction Pump. Duty
800 G.P.M. to Total
Head of 230 ft.



THE MIRRLEES WATSON COMPANY LTD
45 Scotland Street, Glasgow, C.5
Telephone: South 2701/4

Enter No. 1201 on reply card

put power where you want it

Power for many purposes. Power to drive efficiently your plant or product. Power—at slow speed—single, double or triple reduction units giving 45 different gear ratios driven by motors of up to 1 h.p. Power—from sturdy dependable G.E.C. Fractional Horsepower Geared Motor Units.

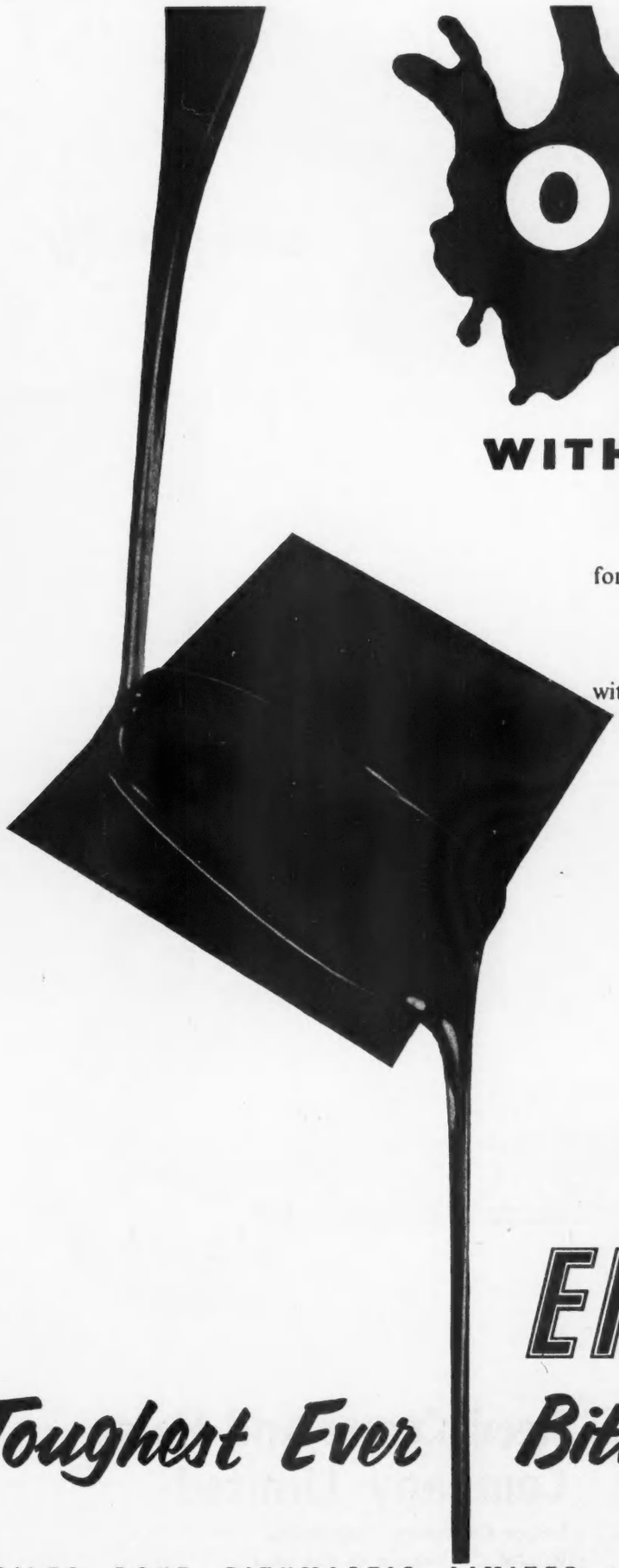
Fully detailed illustrated publication on application.

G.E.C.

fractional h.p.
GEARED MOTOR UNITS

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

Enter No. 1202 on reply card



OIL IS NO PROBLEM WITH THIS COATING

Most protective coatings put up quite a good performance under relatively severe conditions — that is until they come into contact with oils and other solvents. Disintegration then takes place almost immediately. Not so with Epimastic however. This material stands up to a surprising number of chemical conditions without the least impairment of efficiency.

Resistance to oil is only one of EPIMASTIC'S many virtues. Why not write for Technical Leaflet No. 20 for the full story.

EPIMASTIC

Toughest Ever Bituminous Coating

WAILES DOVE BITUMASTIC LIMITED · HEBBURN · CO. DURHAM 167

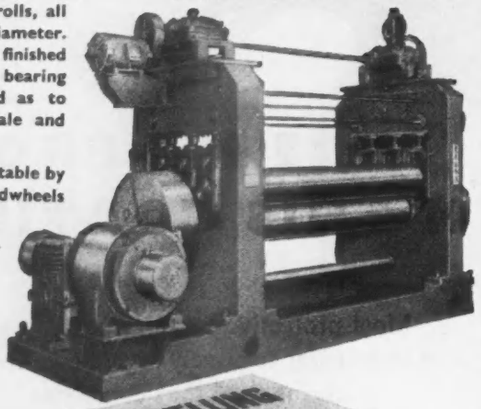
Enter No. 1211 on reply card
P

FOR LEVELLING
8' x 3/4" MILD STEEL PLATE

BRONX

On this Bronx Machine the levelling rolls consist of three top and two bottom rolls, all of which are 12½in. diameter. The roll necks are finished ground, and the bearing assembly so arranged as to preclude entry of scale and other foreign matter.

The top rolls are adjustable by hand with large handwheels provided, or by a 7½ h.p. reversing motor running at 950 r.p.m. The machine is designed to operate continuously at a maximum specified load and output.



5-ROLL PLATE LEVELLING ROLLS

This Bronx 5-Roll Plate Levelling Machine is suitable for levelling cold mild steel plate up to a maximum of 8ft. 0in. in width by ¾in. thickness, and is designed for a levelling speed of 16ft. 0in. per minute. Made in all sizes.

Telephone: LYE 2307 & 2308

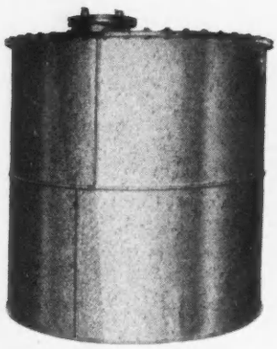
BRONX ENGINEERING CO. LTD., LYE, WORCS.

Enter No. 1221on reply card

complexity

—simplicity→

. . . but each executed with the same precision vital to high grade chemical engineering plant and which can always be found in work carried out by Burnett and Rolfe Limited.

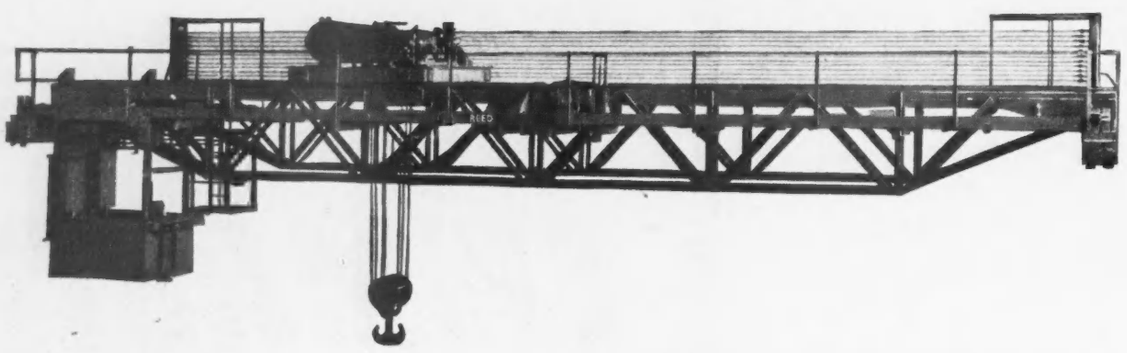


DESIGN AND CONSTRUCTION TO BRITISH, AMERICAN CODES AND LLOYD'S

BURNETT & ROLFE LIMITED
THE ESPLANADE · ROCHESTER · KENT.
Tel: CHATHAM 41766
NORTHERN OFFICE: 32 Deansgate, Manchester. Tel: Blackfriars 9084

Enter No. 1222 on reply card

Overhead Electric Travelling Cranes by **REED**



E.O.T. Cranes up to 50 tons S.W.L. and 100 ft. span
Electric Hoists up to 10 tons S.W.L.
Jib Cranes, Goliath Cranes,
Winches, Telphers & Runways

Full Catalogue sent on Request

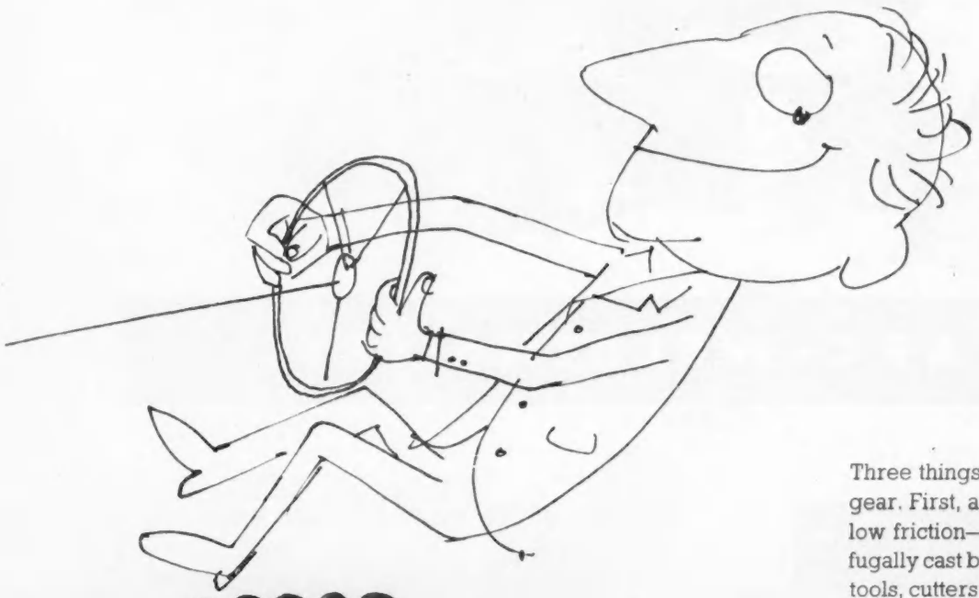
Reed Crane and Hoist Company Limited

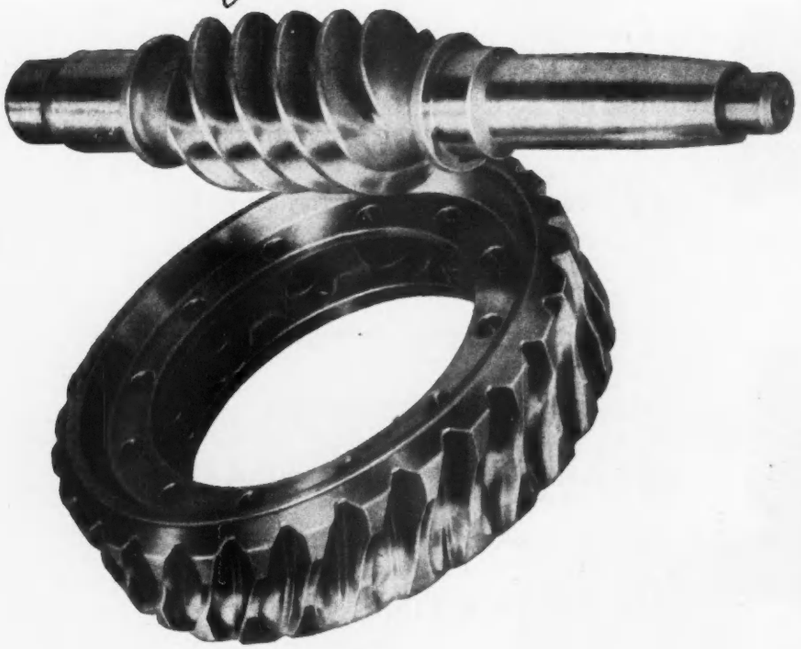
Lodge Causeway, Fishponds, Bristol. Telephone: 65-3237/8 Bristol

Enter No. 1223 on reply card

For a wonderfully smooth drive...

Holroyd worm gears





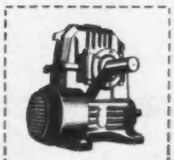
Three things are needed for making a good worm gear. First, a wheel material to give hard wear and low friction—in our case this means Holfos centrifugally cast bronze. Second, high precision machine tools, cutters and testing appliances—we have been making our own for years. Third, a thorough knowledge of worm gear design and application, coupled with an inexhaustible supply of patience—well, we've been in the worm gear business for nearly a century and during that time we've overcome some pretty tough problems. That's why we say: there is (or very soon can be) a Holroyd worm gear for almost every application.

Did you know that all Holroyd worm gears are made using a unique technique which gives some allowance for the inevitable deflection of bearings and gear housing? This gives improved performance with the gears working correctly in the **loaded** position.

In certain cases we go further than this and make the gears so that they have some latitude in assembly without impairing the efficiency.

Another point—our worm gears are made, if required, right down to 1/1 ratio as an everyday product. And don't forget that these Holroyd gears will carry several times the load of straight faced spiral gears of the same dimensions, and will work with an efficiency of the order of 97 per cent.

Have a word with **Holroyd**



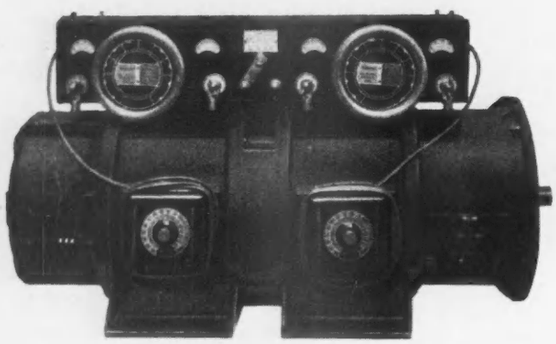
90 YEARS OF GEARS

JOHN HOLROYD & CO LTD · MILNROW · LANCASHIRE

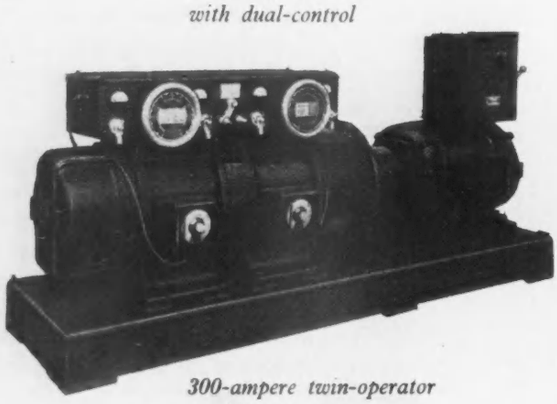
CRC 194

Enter No. 1231 on reply card

ARC-WELDING SETS



300-ampere twin-operator welding-generator with dual-control



300-ampere twin-operator welding-generator, direct-coupled to a 380-volt 3-phase motor, mounted on a bedplate

One of the many Reyrolle activities is the quantity production of d.c. arc-welding generators and their driving motors. Many years of experience in this field has enabled us to design and manufacture a wide range of sets to meet all requirements — fixed units for production lines, and mobile units for constructional work

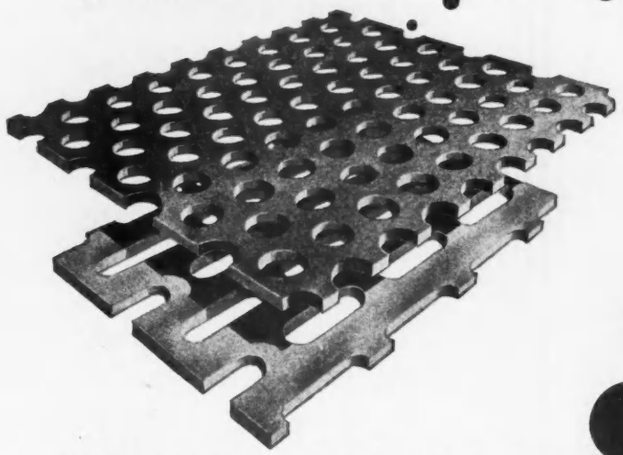
Ask for Pamphlets 1228 & 1264

Reyrolle

A. REYROLLE & COMPANY LIMITED - HEBBURN - COUNTY DURHAM - ENGLAND

Enter No. 1241 on reply card

PERFORATED *Metals*



ANY SIZE OR SHAPE OF HOLE
IN ALL METALS
ACCURATE & DURABLE

Greenings
H. GREENING AND SONS, LTD.
BRITANNIA WORKS
WARRINGTON · ENGLAND
P.O. BOX 22
ESTABLISHED 1799

Telephone: WARRINGTON 32401 Telegrams: GREENINGS WARRINGTON
TELEX No. 62195

NG 55
Enter No. 1251 on reply card

IRON CASTINGS

For Engineering and all Kindred Trades

ANY SIZE ANY SHAPE

ALSO PATTERNS AND MACHINING

HUNT BROS (OLDBURY) LTD
GRIFFIN FOUNDRY, OLDBURY
Near BIRMINGHAM
Telephone: BROADWELL 1101 & 1102 Telegrams: GRIFFIN, OLDBURY

ESTABLISHED MORE THAN 100 YEARS

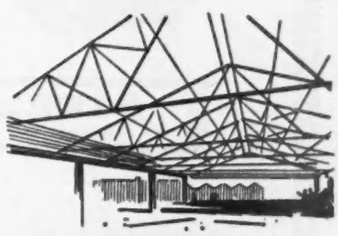
Enter No. 1252 on reply card

HARVEY IRONWORKS

INVITE ENQUIRIES FOR

PLANT HANDLING EQUIPMENT, WELDED FABRICATIONS AND PLATE WORK (TANKS, ETC.) TO SPECIFICATION

PALLETS



ROOF TRUSSING

METAL PARTITIONING

HARVEY IRONWORKS LTD.

337 HOLYHEAD ROAD,
HANDSWORTH, BIRMINGHAM 21
Tel: WEST BROMWICH 2193

Enter No. 1253 on reply card

W. A. BAKER & COMPANY LTD. · WESTGATE WORKS · NEWPORT · MON. · NEWPORT 64845

BAKERS

TAKE THE CAKE FOR CASTINGS

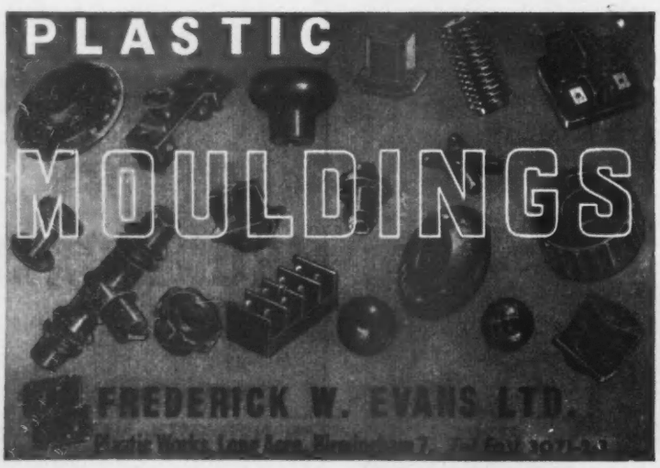
STEEL UP TO TWO TONS

MEEHANITE UP TO EIGHT TONS

The word MEEHANITE is a Registered Trade Mark

Enter No. 1261 on reply card

PLASTIC MOULDINGS



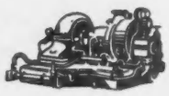
FREDERICK W. EVANS LTD.

Enter No. 1262 on reply card

BROTHERHOOD

VERTICAL AND HORIZONTAL

STEAM TURBINES



Wide range — all types.
Over 50 years' experience.
Scores in hand— thousands in service.

BROTHERHOOD

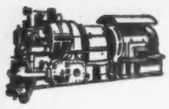
VERTICAL AND HORIZONTAL

COMPRESSORS

Air, Gas and Refrigerating.
The widest range in the British Empire—made to suit your requirements.
Thousands in service.

BROTHERHOOD

GENERATING SETS



Turbine driven up to 11,000 KW.
Engine driven up to 340 KW.
Many in hand, hundreds in service.

BROTHERHOOD

COOLING TOWERS

All types.
Nearly 50 years' experience.

also Manufacturers of all kinds of

PLANT TO CUSTOMERS' OWN DESIGNS

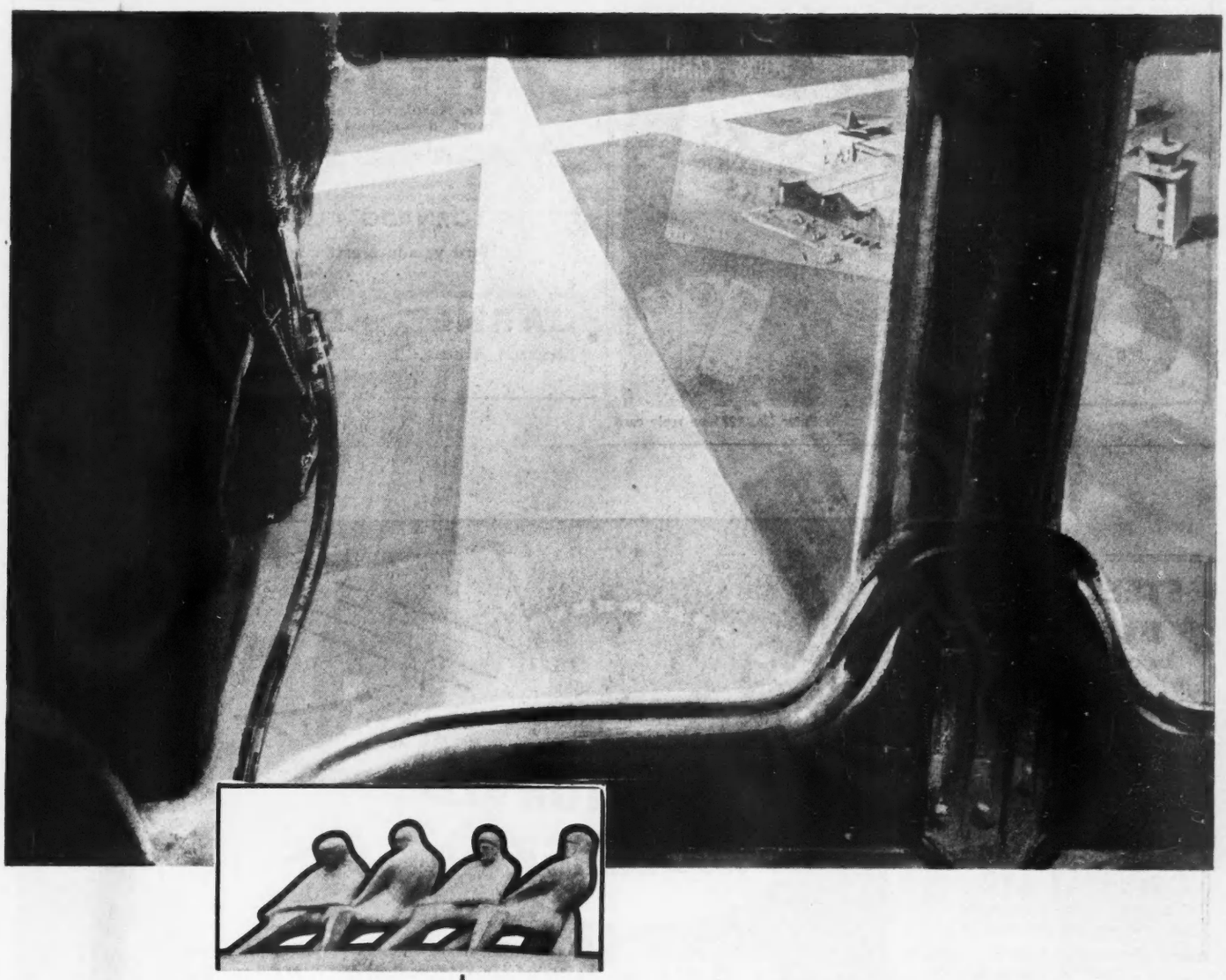
WHY NOT SEND YOUR PROBLEMS TO US?

We shall be pleased to investigate them confidentially without commitment

J. & H. BROTHERHOOD PETERBOROUGH ENGLAND

COMPRESSOR & POWER PLANT SPECIALISTS FOR NEARLY A CENTURY

Enter No. 1263 on reply card



New airports depend on TeamWork

New developments in aircraft, and the rapidly expanding volume of air traffic, demand new and ever larger airports. The Taylor Woodrow organisation has many years experience in this field of construction and has been able to make its own specialised contribution to the development of modern air travel. Not only in the successful completion of world famous projects as London Airport Central but also in its work for the Service Departments and for countries overseas.

Among its current contracts, Taylor Woodrow (in association with D. B. Waite Ltd., of Wellington) is engaged upon the reconstruction of Nandi International Airport, Fiji, for the New Zealand Government.

This includes the construction of runways, aprons and taxiways; the building of administrative offices and the new control tower and the installation of water supply and sewage systems.

Taylor Woodrow's world wide reputation for meeting the standards all clients require — in quality, economy and speed, is firmly based on the spirit of teamwork that inspires the entire organisation.

TAYLOR WOODROW

BUILD EVERYWHERE

BUILDING AND CIVIL ENGINEERING CONTRACTORS

10 PARK STREET · LONDON W1 · GROSVENOR 8871

Enter No. 1271 on reply card

LOVERIDGE LTD
151-153 BUTE STREET, DOCKS, CARDIFF

Manufacturers of Mild Steel
CRANE BLOCKS
SINGLE AND MULTIPLE SHEAVE
TACKLE BLOCKS
& PATENT SNATCH BLOCKS
FOR WIRE ROPE

ILLUSTRATED LISTS ON REQUEST

Telephone: Cardiff 23641 (5 lines)

Enter No. 1281 on reply card

AIR CLEANSING...
THE TORNADO WAY

Mr. Manufacturer please do not allow your employees to work in conditions where air pollution exists.

Dirt costs time and money!

For a very reasonable outlay you can protect your staff from dangerous fumes, grit and dust, by using the :—

TORNADO CLEAN AIR EQUIPMENT

Are you interested SIR?

If so please phone at once and allow us to quote.

Fully trained personnel are at your disposal.

BARNET METAL CO. LTD.
Elektron House, Brookhill Road, New Barnet, Herts.
Telephone: BARnet 3901/5187.

Enter No. 1284 on reply card

STEEL FRAME BUILDINGS
OF EVERY DESCRIPTION
Factories, Sheds, Mill Buildings, Foundries, Bungalows, Etc.

SPECIALITIES
Pit Headgear, Pumping Stations, Power Stations.

Bridgework and Riveted Work of all descriptions

BROWNLIE and MURRAY LTD.
POSSIL PARK, GLASGOW
LONDON: 32, QUEEN VICTORIA ST. E.C.4

Enter No. 1282 on reply card

D.C. MOTOR PROBLEMS?
-let E.P.E. solve them for you quickly
In these days of AC it is not always easy to get DC motors and generators quickly and at a reasonable price. Fortunately, EPE specialise in DC equipment, bringing years of experience to bear on the subject, so that one can always be sure of DC motors and generators, of any enclosure, at competitive prices, on short delivery. EPE are always happy to help solve DC problems, too.
E·P·E
ELECTRICAL POWER ENGINEERING CO. (B'ham) LTD.
Bromford Lane, Birmingham 8
'Phone: STEchford 2361
'Grams: Torquo 'Phone Birmingham
London Office: 421, Grand Buildings, Trafalgar Square, W.C.2. 'Phone: WHitehall 5643 and 7963

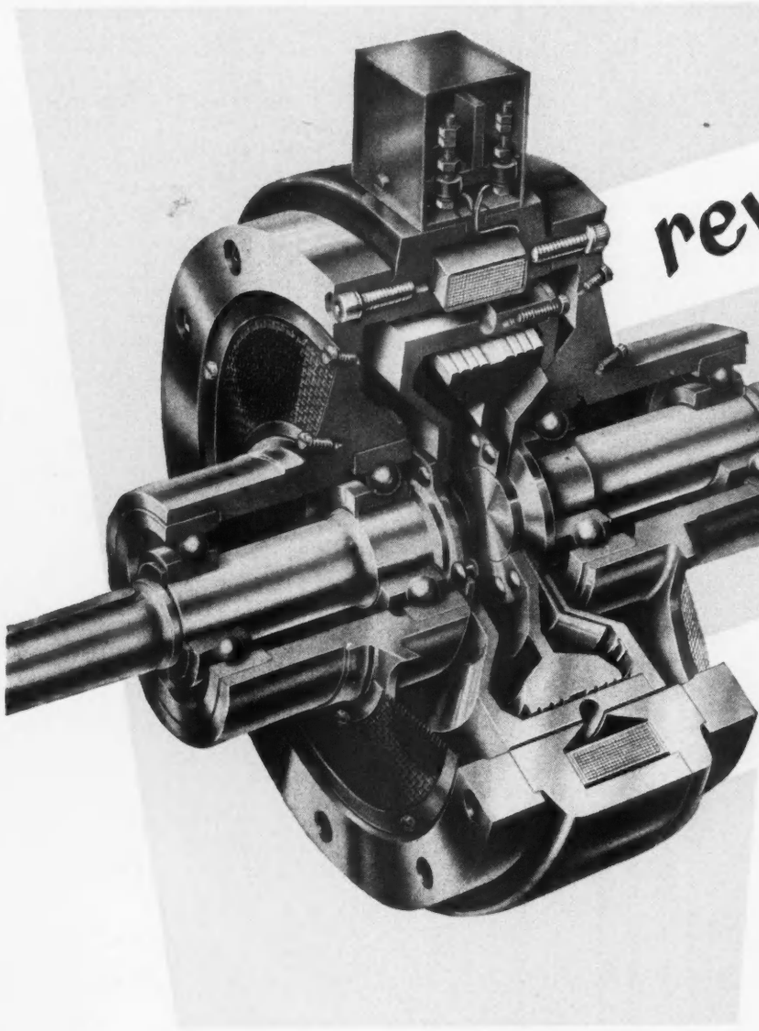
Enter No. 1285 on reply card

Specify
MICHELL
AND MAKE SURE OF YOUR
BEARINGS

THEY SET THE COURSE FOR RELIABILITY
FOR Turbine Thrusts, Pedestal Bearings, Hydro-Electric Installations, Motors, Generators, Paper Making and Extruding Machines, Pumps, Fans, Etc., Etc.

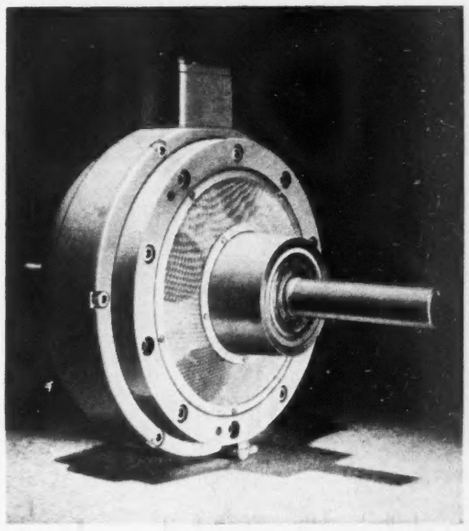
MICHELL BEARINGS LTD
SOUTH BENWELL
NEWCASTLE upon TYNE, 5
Telegrams: MICHBEARO Telephone: 3427

Enter No. 1283 on reply card



revolution in rotation

SMITHS
Magnetic Particle COUPLING



This is a positive coupling working on a new principle. It is NOT a magnetically operated clutch, and there are no plates to wear.

Driving and driven members are coupled by magnetically activated particles, giving perfectly smooth take-up and accurate control of torque. Eight standard units are made ranging from 1/3 to 200 lb/ft.

SMITHS S. SMITH & SONS (ENGLAND) LIMITED

INDUSTRIAL PRODUCTS DEPARTMENT, WITNEY, OXON · Telephone: WITNEY 678

AP/85

Enter No. 1291 on reply card

Q

transformers

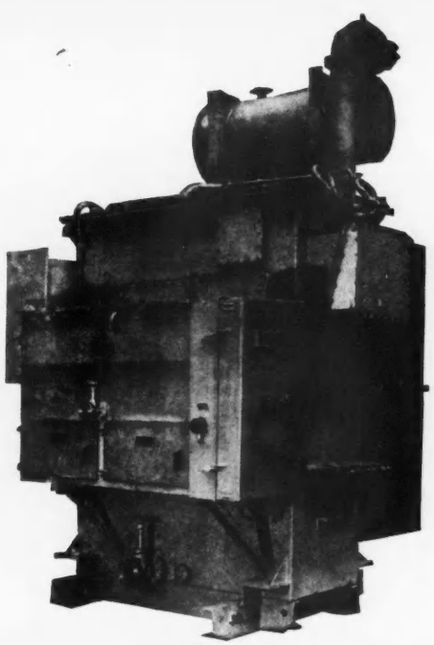
INDIA 7500 kVA 132/33 kV
transformer for Madras.

CHILE 5000/6250 kVA 66/16 kV transformer.

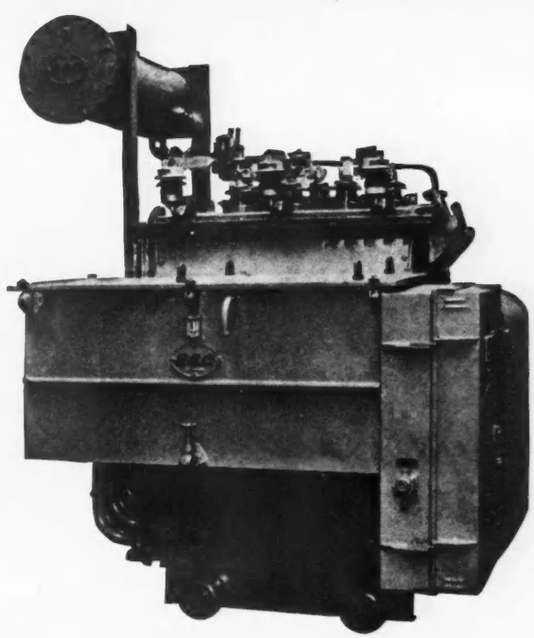
G.E.C. power

for the world

In lands as far apart as Canada and Chile — as India and South Africa — G.E.C. transformers are helping to bring the manifold benefits of electric power to the peoples of the globe. For the world has come to rely on the transformer equipment developed, manufactured and installed by the skilled technicians of this great organisation.



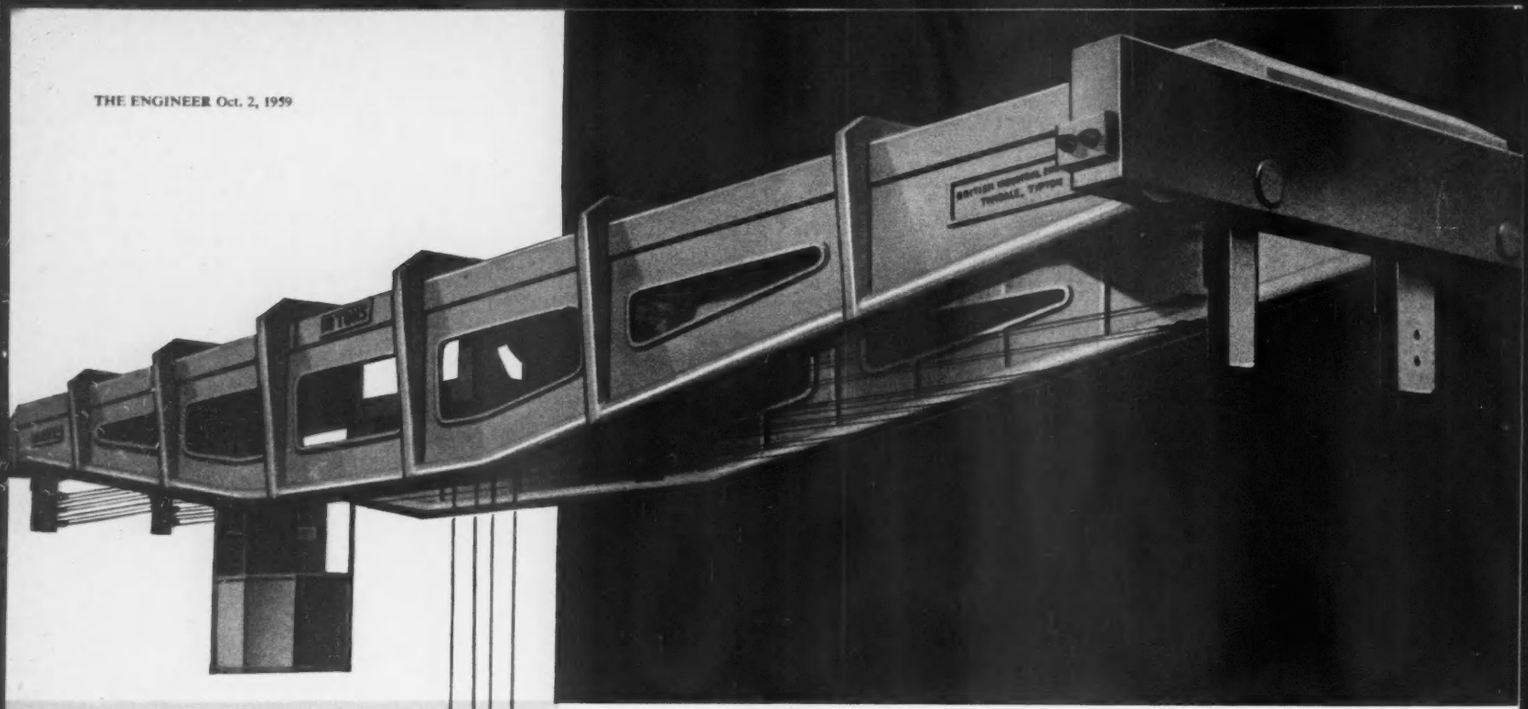
CANADA 2500 kVA 13.8/2.4 kV 60 c/s transformer fitted with on-load tap-changing switch for Niagara.



SOUTH AFRICA 2500 kVA 3.3/3.3 kV transformer fitted with on-load tap-changing switch for the Rand mines.

transmission equipment

HEAD OFFICE: MAGNET HOUSE KINGSWAY LONDON WC2 · THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND.



BUSINESS IS LOOKING UP -WITH REEL OVERHEAD

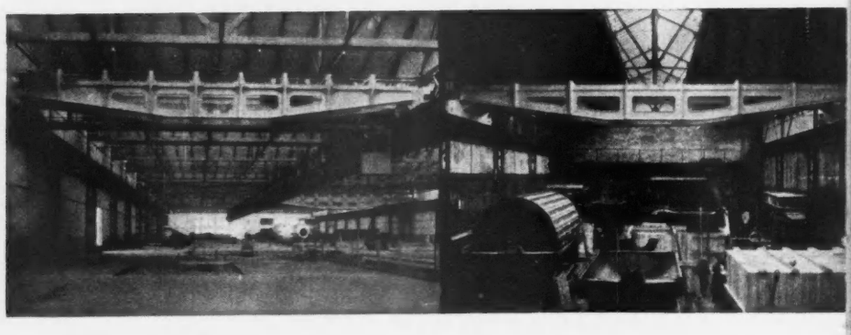
Manufactured under licence from Ferrand & Frantz Ing. Villeurbanne. British Patent No. 705,148.

The remarkable performance of REEL overhead cranes has been proved conclusively on hundreds of installations. The new approach to overhead crane design has put REEL well ahead. Conventional boxed lattice frames have been replaced by clean-lined girders providing greater strength and lightness, with a consequent saving in power consumption. REEL Cranes can be carried to within two or three inches of the roofwork and in capacities to suit your individual requirements. *Full information on request.*

THE BRITISH

"RÉEL"

OVERHEAD CRANE



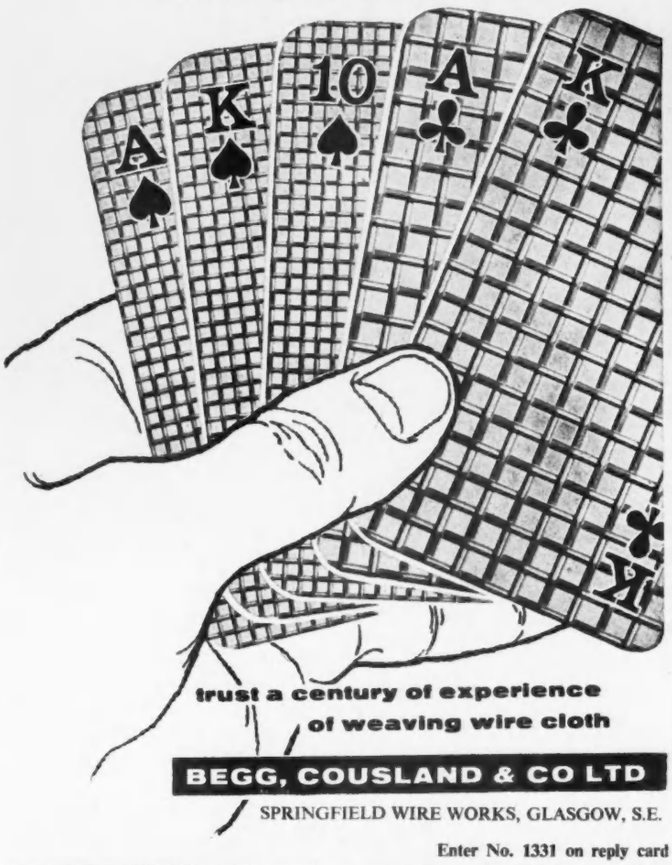
BRITISH INDUSTRIAL

ENGINEERING COMPANY (STAFFS) LIMITED

CORONATION WORKS, HAINGE ROAD, TIVIDALE, TIPTON, STAFFS. TEL: TIPTON 1222 3/4.

Enter No. 1321 on reply card

Never trust to luck with woven wire

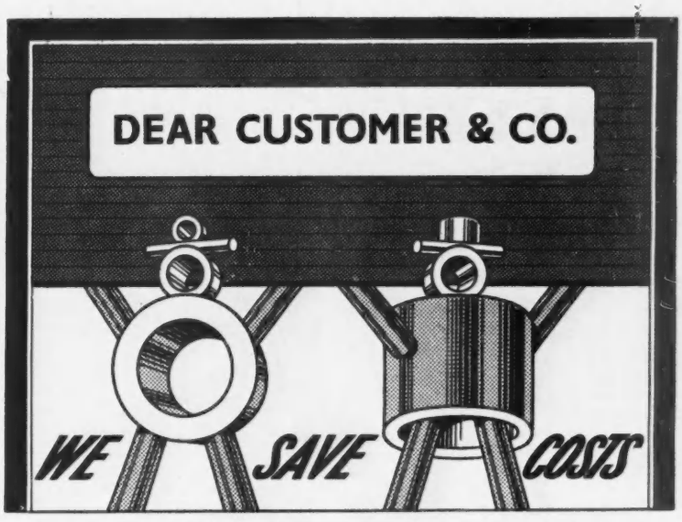


trust a century of experience of weaving wire cloth

BEGG, COUSLAND & CO LTD

SPRINGFIELD WIRE WORKS, GLASGOW, S.E.

Enter No. 1331 on reply card



Seamless Steel Tubes for Machining

OPEN ALSO YOUR DOORS FOR SAVING TIME—MATERIALS—LABOUR

THEY ARE AVAILABLE IN MANY SIZES TO SUIT YOU

Please send enquiries to:

BRITISH & GENERAL TUBE Co. LTD.,

TRADING ESTATE · SLOUGH, BUCKS.

Phone: SLOUGH 24171 (5 lines) *Telex: 84100 TUBECO, SLOUGH*

Grams: TUBECO, SLOUGH, TELEX

Suppliers also of Welded and Seamless Tubes for Gas, Water and Steam, Boiler Tubes, Cold Drawn Seamless and Electrically Welded Precision Steel Tubes.

Enter No. 1332 on reply card

TUNNELLING SHIELDS

by

WESTWOODS

We manufactured the two 31 ft. diameter Tunnelling Shields which were used at Potters Bar in connection with the doubling of the permanent way under the British Transport Modernisation Scheme.

Chief Civil Engineer, British Railways Eastern Region: A. K. Terris, M.I.C.E.

Main Contractors: Messrs. Charles Brand & Son Limited. *Consulting Engineers: Sir William Halcrow & Partners.*

SCHEMES SUBMITTED

JOSEPH WESTWOOD & CO. LTD.

NAPIER YARD, MILLWALL, LONDON, E.14. ***Tel: EASt 1043***

Cables: Westwood London. ***'Grams: Westwood Easphone London.***

Contractors to H.M. Government Departments, Crown Agents for the Colonies, British Railways (British Transport Commission) etc., etc. Bridge and Constructional Engineers, Manufacturers of Mechanical Grabs, Pressed Steel Troughing and Sheet Metal Equipment. Steel Stock Holders.

Enter No. 1333 on reply card

Who are the best people
for grinding & sifting plants?

C & N....
C & N ...
C & N ..
Christy ...
Christy and
something ...
Christy and
Norris
that's it ...

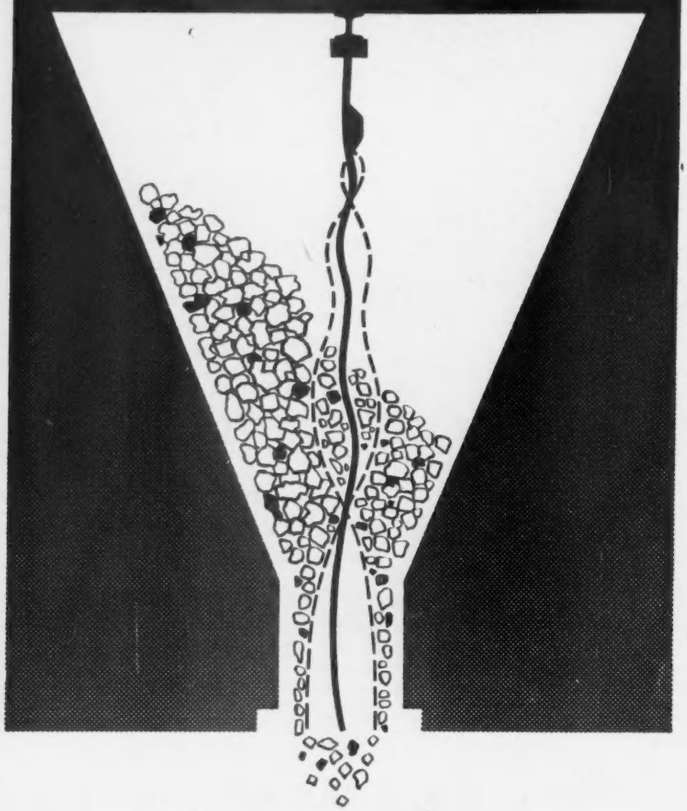
CHRISTY & NORRIS, LTD
CN

DISINTEGRATORS, PULVERIZERS & LABORATORY MILLS including a range of mills in PHOSPHOR BRONZE OR STAINLESS STEEL SIFTING & MIXING MACHINES ETC.
Complete grinding and sifting plants, designed and installed.

Chelmsford · Essex · Telephone: 3414-7

Enter No. 1341 on reply card

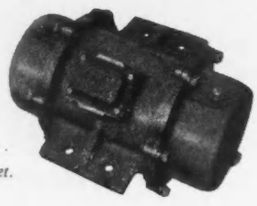
Efficient Bunker Discharge



The problems of efficient discharge of material from large storage bunkers where external vibration is impractical is simply overcome by the installation of the new Sinex Internal Bunker Vibrator. The device comprises a Sinex rotary electric vibrator attached to a steel reed which hangs down into the bunker. The unit is suspended from a rolled steel joist and anti-vibration mountings protect the hopper structure itself. Maximum amplitude occurs at the tip of the reed or at the point where stoppage has built up, releases the material and ensures a smooth, free flow. Sinex Internal Bunker Vibrators are completely reliable, the power unit being readily accessible and causing no obstruction to the material inside the hopper.

Sinex
INTERNAL BUNKER VIBRATOR

A new range of Sinex rotary electric vibrators has been designed to eliminate disadvantages normally associated with this equipment. Available in four sizes providing centrifugal forces up to 300, 500, 1,960 and 7,600 lb. respectively.



Send for relevant details and information sheet.

SINEX ENGINEERING COMPANY LIMITED
Central Way, North Feltham Trading Estate, Feltham, Middlesex
Telephone: Feltham 5081 (5 lines) Telegraphic Address: Sinexvibro Feltham
ASSOCIATED COMPANIES IN PARIS, BRUSSELS AND ZURICH

Enter No. 1342 on reply card

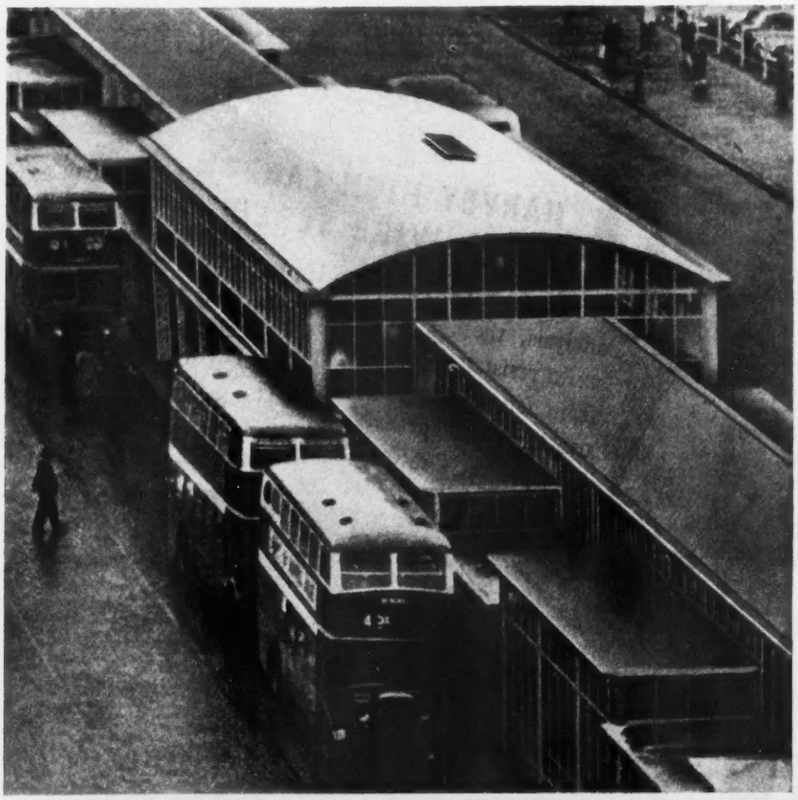
Another storey in modern architecture

with

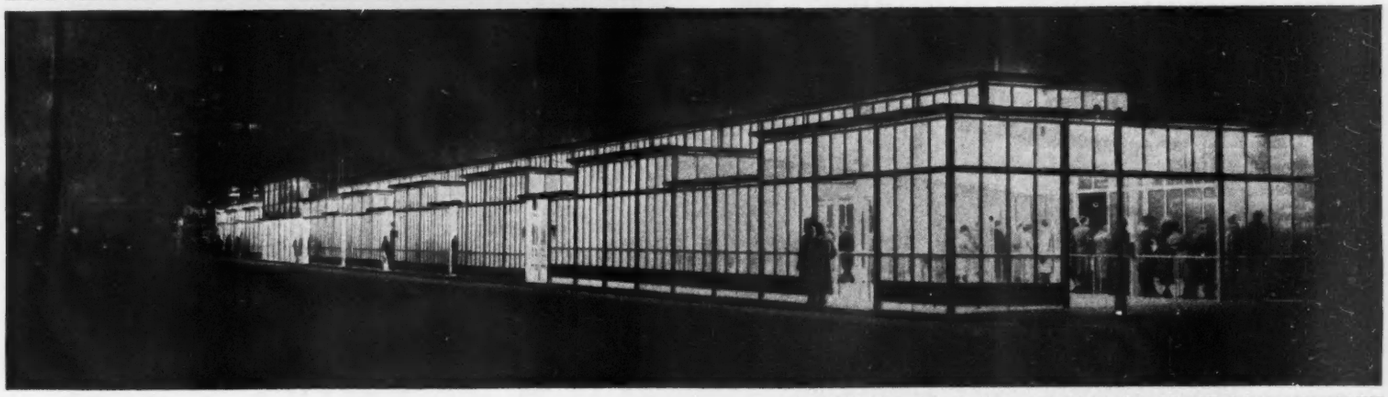
DURALUMIN

REGD. TRADE MARK

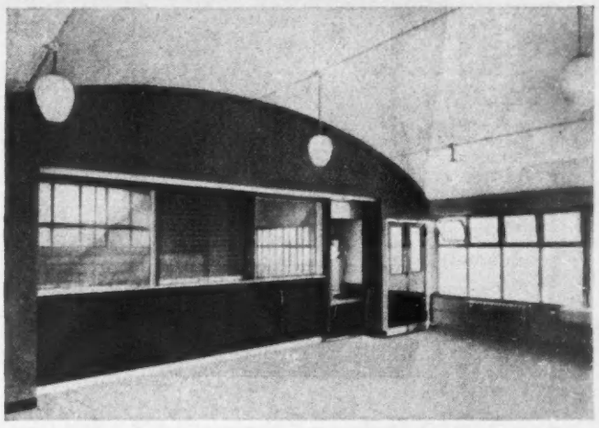
IN IT



One of the most striking features of Manchester's new bus shelter is the unique central block—believed to be the first two-storey building in this country to be built entirely on structural light alloy columns. These extruded 'Duralumin H' supports are used along the full 577 foot length of this extensive structure, as well as the two-storey block. Architectural interest and simple maintenance are combined in a building capable of holding a thousand people at a time.



The central block has a 21 foot radius concrete roof 2½ in. thick, and the first floor is of 4 in. thick concrete. The supporting columns are made from extruded 'Duralumin H' hollow sections with a wall thickness of .280 in. A number of these columns incorporate an integral rain water down pipe and a double hollow section was used for this purpose. The natural appearance of the Duralumin supports is attractive and, because of its good resistance to corrosion, the structure will never need a coat of paint.



If you would like advice on any aspect of aluminium alloys, please let us know. We have wide experience and our Technical Sales Section is always ready to help.

DELTA GROUP LONDON & BIRMINGHAM

JAMES BOOTH & COMPANY LIMITED · ARGYLE STREET WORKS · BIRMINGHAM 7

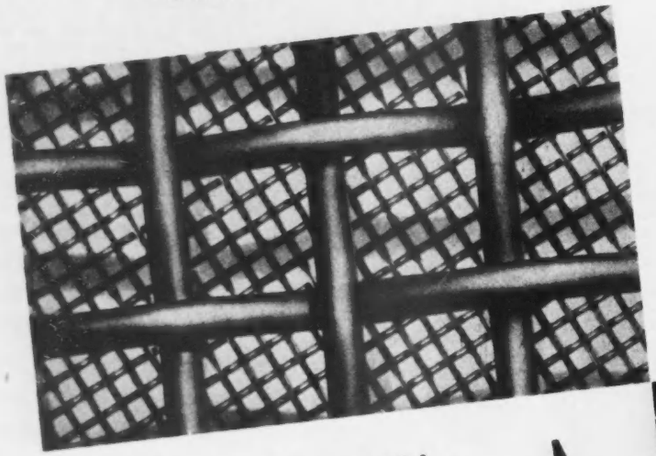
Extrusions, large forgings, plate, sheet, strip, tubes and wire in brass and copper, as well as light alloys

TGA 1BG 104

Enter No. 1351 on reply card

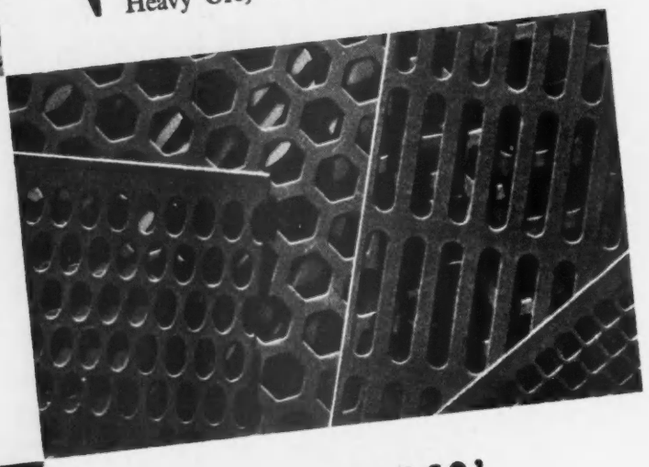
3 THINGS TO REMEMBER

WHEN ORDERING SCREENS AND FILTERS



1 HARVEY HIGH CARBON STEEL WIRE SCREENS

Woven from steel made to Harvey's own analysis, these screens offer the maximum resistance to abrasion and fracture from fatigue. Highly recommended for use with all grades of Coal, Stone, Heavy Ore, Granite, Sand and Gravel.



2 'HARCO' PERFORATED METALS

Highest quality metals with clean and accurate perforations ensure long life and trouble-free service. A wide range of sizes and patterns is available, including many for specialised purposes. Ornamental and embossed patterns also supplied.

3 'HARCO' WOVEN WIRE

Uniform and dependable sizing makes this the ideal cloth for powders and liquids. Any gauge and any mesh can be supplied in a wide range of metals covering all industrial uses. Complete Filters and Strainers of various types also supplied.

Illustrations and details are in our Catalogues Nos. 926 and 1042. Please send for copies.

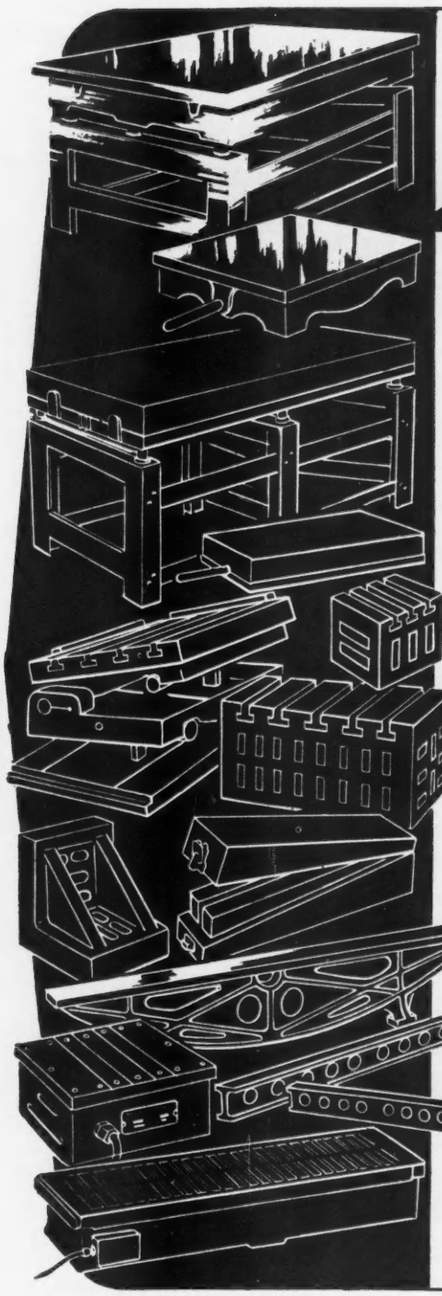
HARVEY

G. A. HARVEY & CO. (LONDON) LTD.
WOOLWICH ROAD · LONDON · S.E.7
Telephone: GREenwich 3232 (22 lines)

Other HARVEY Facilities and Products: CLASS 1 WELDED PRESSURE VESSELS TO LLOYD'S AND A.S.M.E. CODES · DIE-PRESSED AND 'ROTARPREST' HEADS UP TO 15 ft. DIA.—*Larger sizes to specification* · SHEET METALWORK OF EVERY DESCRIPTION · HEAVY MACHINING & FITTING · STEEL SHELVING & STORAGE EQUIPMENT · GALVANIZING · TANKS, CISTERNS & CYLINDERS

W/Wg/P/2

Enter No. 1361 on reply card



CROWN

SURFACE PLATES AND TABLES. Made from hard close-grained cast iron. Sizes from 6in. by 4in. up to 12ft. 0in. by 6ft. 0in. in Grade "A" and "B" accuracy.

GRANITE SURFACE PLATES AND TABLES. Made from hard close-grained black Swedish granite. Sizes from 8in. by 8in. up to 10ft. 0in. by 5ft. 0in.

SINE TABLES. Simple or Compound Angle types. Supplied with Electro Magnetic, Non-electric Magnetic or "T" slotted work faces. Sizes 8in. by 5in., 10in. by 5in. and 12in. by 8in.

ANGLE PLATES AND BOX ANGLE PLATES. Made from hard close-grained cast iron and rigidly designed for stability. Grade "A" and "B" in all sizes.

STRAIGHT EDGES. Cast Iron Camel Back and "I" Section types from 12in. up to 16ft. 0in.

PARALLELS. Hardened Tool Steel to B.S.S. Grade "A" and "B". Complete in wooden case. Sizes 4in. up to 16in.

MAGNETIC CHUCKS. Made from high permeability steel castings and having exceptional holding power. Sizes from 12in. by 6in. up to 72in. long.

DEMAGNETISERS. Of new design to cope with all demagnetising problems,

LAPPING BLOCKS. Made from hard close-grained cast iron surfaced on top and bottom faces and grooved for lapping. Complete with cover for each face. Sizes 6in. by 4in. up to 12in. circular.

WINDLEY BROS · LTD
CROWN WORKS
CHELMSFORD · ENGLAND
Telephone CHELMSFORD 2224

Enter No. 1371 on reply card

McNEIL

manhole doors for air-receivers, boilers, etc.

HEAVY STEEL PRESSINGS

FOUNDRY LADLES

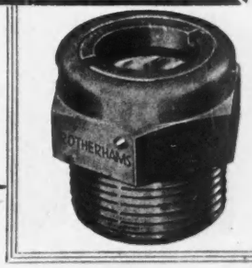
FABRICATED STEELWORK

WELDED CENTRAL HEATING BOILERS

CHARLES McNEIL LIMITED
KINNING PARK HYDRAULIC FORGE
570 SCOTLAND STREET, GLASGOW, S.1.
Grams: "McNeil, Glasgow" Phone: South 1131

Enter No. 1373 on reply card

OIL SIGHTS FOR MACHINE TOOLS



Accuracy to finest limits is automatically expected of every Rotherham product. The type of Oil Sight for Machine Tools illustrated serves to strengthen this confidence in Rotherham quality. This pattern is threaded ¾" B.S.P. Other sizes may be quoted for in production quantities. Remember us also for brass T, Y, 4-Way and Elbow Pieces, Brass Taps of all kinds, Brass Grease Cups, Winkley Oilers, etc.

Rotherhams OF COVENTRY

ROTHERHAM & SONS LTD.
COVENTRY. *Tele: 64154*
PRECISION MANUFACTURERS SINCE 1750

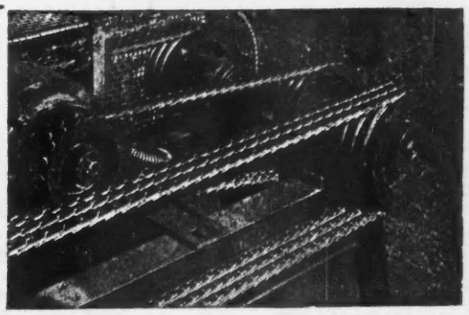
Enter No. 1374 on reply card

RIVLINK

The SUPER BELT

for all VEE DRIVES

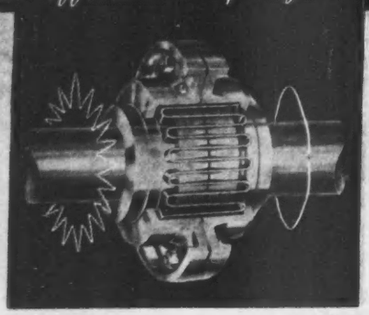
- Made in RUBBER FABRIC
- Least Stretch—Longest Life
- Each Link a Complete Unit
- Detachable and Adjustable



RIVLINK BELTS LTD.
NORTH STREET · OPENSHAW
MANCHESTER 11 Telephone: EASt 2302

Enter No. 1372 on reply card

The most efficient couplings obtainable



BIBBY *Resilient* COUPLINGS

For nearly forty years Bibby Resilient Couplings have enjoyed an unexcelled reputation for efficiency and reliability and numerous Couplings supplied over thirty years ago are still giving trouble-free service.

The outstanding resilience of Bibby Couplings dampens shocks and vibrations, ensures smooth running of plant, eliminates breakdowns. Standard Couplings up to 7½" bore can be supplied from stock.

We invite you to write for our illustrated brochure.

THE WELLMAN BIBBY COMPANY LIMITED
PARNELL HOUSE, WILTON ROAD, LONDON, S.W.1

Enter No. 1381 on reply card

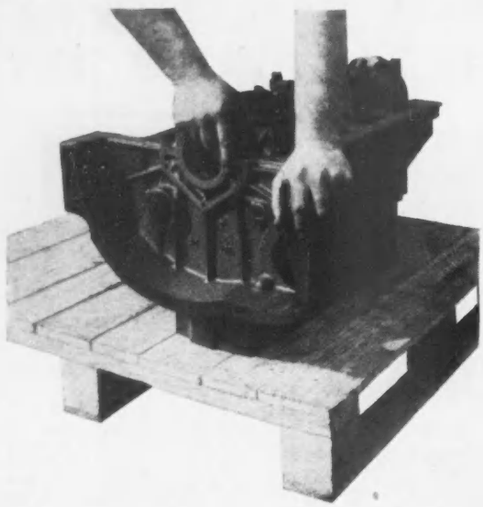
Rubber Mouldings

Only a few examples of the hundreds of mouldings produced by Clyde Rubber. For the answer to your next moulding problem contact us.

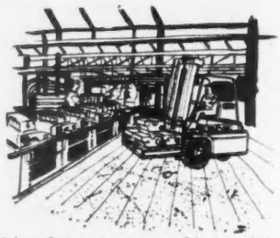
CLYDE RUBBER WORKS COMPANY LTD.

SPECIALISTS IN RAILWAY ROLLING STOCK EQUIPMENT
P.O. BOX No. 7. RENFREW
Telephone: Renfrew 2384. Telegrams: Rubber, Renfrew. Telex-70.

Enter No. 1382 on reply card



POWER for industry



Our range of industrial engines are a practical proposition for many types of industrial equipment . . . **fork lift trucks, compressors, cranes, pumps, contracting equipment, earth borers, generators, railcars, welding plant, works trucks, tractors and conversions.** Simple design, modern flow-line production methods and common interchangeable parts contribute to the low cost of these high efficiency engines. And remember, every engine is fully backed by a World-wide Parts and Service Organisation. Take your choice from a wide power range . . . Diesel 20 to 86 b.h.p. and Petrol 11 to 87 b.h.p. (12-hr. rating). **DIESEL ECONOMY**—have you considered the replacement of existing power units in your equipment and trucks with the famous 4D Diesel engine? You'll have the unique advantages of economy, long-life and low running costs . . . plus the best service in the World!

Wherever you are, whatever your problem,

FORD

MOTOR COMPANY LIMITED · ENGLAND
are at your service

For further details of our

INDUSTRIAL ENGINES

and the equipment they power, send the coupon to your nearest Ford Dealer or direct to

Please send me technical brochures of your *PETROL/DIESEL Industrial Engines. The maximum B.H.P. required is ..... at ..... R.P.M. Also, please send details of the following equipment powered by your engines.

Name .....

Address .....

.....

Nature of Business .....

..... Telephone No. .....

**Delete where not applicable* GSI-22-10

FORD MOTOR COMPANY LTD · PARTS DIVISION (GS1) · AVELEY DEPOT · SOUTH OCKENDON · ROMFORD · ESSEX · ENGLAND

Enter No. 1383 on reply card

This man knows...

Experience counts in "V" Belt inspection

... that for

GREAT STRENGTH
MAXIMUM FLEXIBILITY
MINIMUM STRETCH

IT PAYS TO SAY

TURNERS
'V' BELTS

The Mark of Better Belting

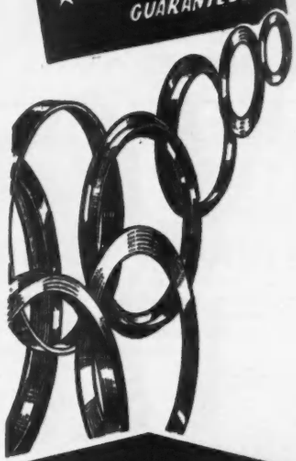
TURNER BROTHERS ASBESTOS CO LTD ROCHDALE
A MEMBER OF THE TURNER & NEWALL ORGANISATION

dmTA131

Enter No. 1391 on reply card

MILLERS RINGS LTD

★ QUICK SERVICE
★ ANY TYPE SECTION
★ TRUE DIAMETER GUARANTEED



HENEAGE STREET, LONDON E.1
BISHOPSGATE 7314

Enter No. 1392 on reply card

Boilerine Ltd.
Manufacturing Chemists

Boilerine
Descaler For Steam Boilers
Torrefine
Bottle Washer
Torrefine Cream
For Glass Lined Tanks
Organic Rosseline
Domestic Boiler Descaler
Chromium Polish
Chromium Cleaner
Torrefine Household Cream
For Gas Stoves and all Domestic uses
All enquiries & orders will receive prompt attention
885a to 897 OLD KENT ROAD, LONDON, S.E.15.
Telephones: NEW CROSS 0061-2

Enter No. 1393 on reply card

HIGH CLASS ENGINEERING ALLOYS

"DELTA" BRAND (Regd. Trade Mark)

BRONZE, BRASS, YELLOW METAL, NAVAL BRASS, COPPER, &c.

EXTRUDED METALS

ORIGINAL AND LARGEST MANUFACTURERS:

THE DELTA METAL COMPANY LTD.

LONDON AND BIRMINGHAM

Enter No. 1394 on reply card

Forgings

IN IRON & STEEL
UP TO 1½ CWTS.

GEORGE MILLS (ENGINEERS) LTD.
Established 1920
214-218 RAVENSCROFT RD., BECKENHAM, KENT
Telephone: SYDenham 5353

A.I.D. APPROVED

A.R.B. APPROVED

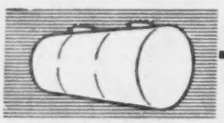
PROTOTYPES AND SPECIAL PURPOSE MACHINES

HEAVY AND "AWKWARD" MACHINING & GRINDING

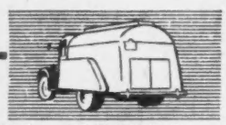
REPAIRS & SALVAGE BY METAL DEPOSITION IN STELLITE, CHROME, NICKEL Etc.

WELDING FABRICATING PROFILE FLAME CUTTING AND GENERAL PRESSWORK

Enter No. 1401 on reply card

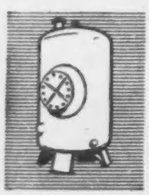


M.S.L
Electrically Welded

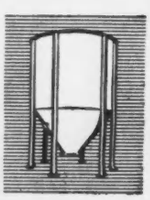


STORAGE & TRANSPORT TANKS

As supplied to all Ministries, Principal Oil Companies & Petrol Pump Manufacturers
For every storage and transport purpose. Steel Horizontal Tanks, Cylindrical Underground Tanks, Fuel Oil Tanks, Road Wagon Tanks, Rectangular Tanks, Air Receivers, Vats, Hoppers, etc.
When ordering specify M.S.L.



25 Years experience in Fabricated Arc-Welding Construction



Write for full particulars to :—
METAL STRUCTURES, LTD.
Angel Factory Colony, Angel Rd., Edmonton, N.18
Phone: Edmonton 6601/2/3 Grams: Metstru, Southtot, London

Enter No. 1402 on reply card

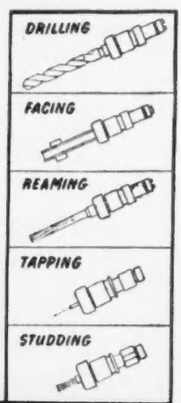
WITH THE NEW 'Jay-Dee' UNIVERSAL ATTACHMENT

you can INCREASE PRODUCTION by 50%

Split-second tool changing gives you all operations applicable to the art of drilling!

ONE SETTING IS ALL YOU NEED

The amazing "JAY-DEE" Universal Attachment saves you time, labour and money at every turn! Staying permanently in position, needing no adjustment by the operator, it carries out one perfect job after another, rapidly and safely. The "JAY-DEE" is adaptable to all drilling machines, combination lathes, turning and boring mills, and can readily undertake the duties of any three turret stations.



CLYDESIDE MACHINE TOOL CO., LTD.,
361 MYRESIDE STREET, GLASGOW E.2.
SHEttleston 4123.

FREE DEMONSTRATION!
A demonstration of the "JAY-DEE" Universal Attachment can be arranged to suit your convenience, at your works.

Enter No. 1403 on reply card

EAGLE BRAND DROP FORGED SPANNERS

DROP FORGINGS OF QUALITY FOR ALL PURPOSES

VAUGHAN BROS (DROP-FORGINGS) LTD.
EAGLE WORKS · WILLENHALL · STAFFS.

Enter No. 1404 on reply card

IF YOU USE POWER YOU NEED FERODO!

- Longer life with fewer replacements
- Smooth transmission of power
- Safe, dependable braking and control

Fit Ferodo first—to last

FERODO

FRICTION LININGS FOR INDUSTRY

FERODO LIMITED · CHAPEL-EN-LE-FRITH · *A Member of the Turner & Newall Organisation*

8/44

Enter No. 1411 on reply card

CZECH MACHINES
of highest quality and workmanship
available for Immediate Delivery from our London Showrooms

ZBROJOVKA Types FA.2., FA.3., FA.4. and FA.5. Plain Horizontal, Universal and Vertical Milling Machines.

PLAUERT Models H.63—2½″ Spindle; H.80—3⅛″ Spindle; and H.100—4″ Spindle; Horizontal Boring, Drilling and Facing Machines.

KAMENICEK Universal Tool and Cutter Grinders.

KAMENICEK Model 1U (10″ × 15″); 2U (12″ × 20″, 12″ × 30″, 12″ × 40″) Universal Grinding Machines.

ZBROJOVKA 10″ × 20″, 10″ × 30″ and 12″ × 40″ Universal Grinding Machines.

KAMENICEK Model BUA.31 Fully Automatic Universal Production Grinding Machine—12″ × 40″.

VOLMAN Model C.45 Straight Bed S.S. & S.C. Lathes; 18″ swing; 60″ and 80″ between centres.

SKODA Model SU.50 Heavy Duty Centre Lathes; height of centres—10″; distance between centres—60″.

SKODA Model SU.63 Heavy Duty Centre Lathes; height of centres—12½″; distance between centres—80″.

SKODA Model SU.80 Heavy Duty Centre Lathes; height of centres—15¾″; distance between centres—110″.

SKODA Type HO.12 Double Housing Planing Machines; planing length—13′ 1″ and 19′ 8″; planing width—49″; planing height—43″. Complete with two Rail Heads, right-hand Side Head and left-hand Side Head.

SKODA Model SK-12 Vertical Boring and Turning Mill; maximum swing—53″.

Selson MACHINE TOOLS

We welcome your inspection—kindly telephone or write to us for full details.

SOLE AGENTS:

THE SELSON MACHINE TOOL CO. LTD.

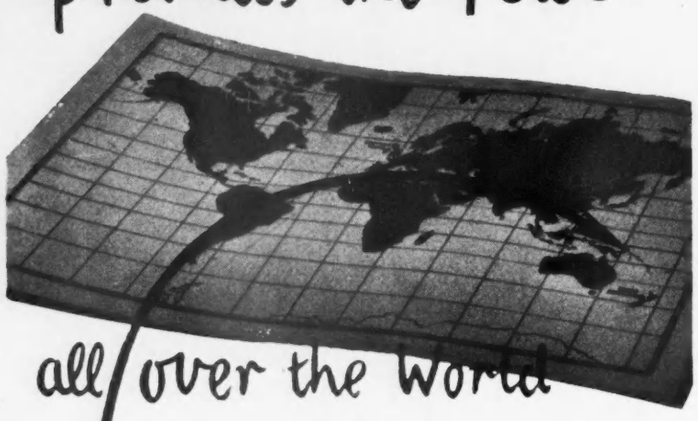
SUNBEAM ROAD, LONDON, N.W.10 — *Telephone: ELGar 4000*

STANNINGLEY, Near LEEDS — *Telephone: PUDsey 2241*

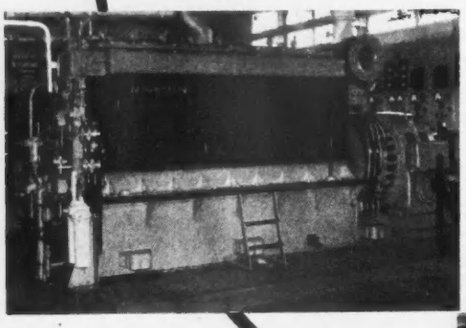
And at Kingsbury (Nr. Tamworth), Manchester, Glasgow, Swansea, Newcastle-on-Tyne, Sheffield, Southampton, Belfast, Bath.

Enter No. 1421 on reply card

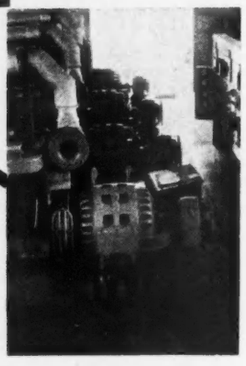
LISTER BLACKSTONE
provides the power



all over the world



IN RABAUL, New Britain, electricity is supplied by four 320 kW alternators, each powered by a Lister Blackstone EVS8 480 h.p. diesel engine.



Photos by courtesy of the Commissioners of Australia Dept. of Works & Housing.

LISTER BLACKSTONE

BLACKSTONE & CO., LTD.

A member of the Lister group of companies

DURSLEY, GLOUCESTERSHIRE, ENGLAND

Phone: 2371 **Telegrams & Cables: Blackstone, Dursley**

London Office: Imperial House, Kingsway, W.C.2. **Phone: TEMple Bar 9681**

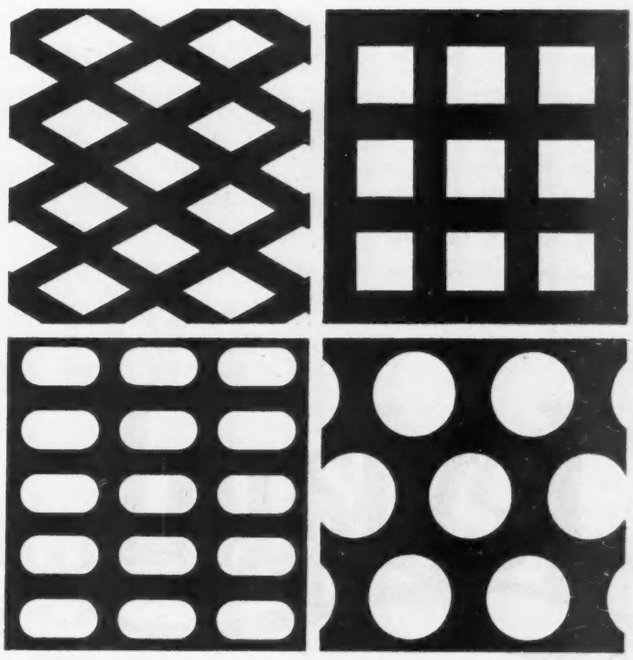
MEDIUM SPEED DIESEL ENGINES FROM 3 TO 1320 B.H.P.

Enter No. 1422 on reply card

Braby

PERFORATIONS

Holes are all very well—in the right place. We undertake to see that holes don't get out of hand. Our standard tools will provide perforations of most shapes and sizes, in any material in common use. You select the sort of holes you want and we will punch them, either in metals we supply, or in your own materials. And if we haven't got the tools, we will make them to do your particular job.



FREDERICK Braby & COMPANY LIMITED

LONDON : 352-364 Euston Road, N.W.1
Telephone : EUSton 3456

CRAYFORD : London Works, Thames Road, Crayford, Kent
Telephone : Crayford 26262

Glasgow · Liverpool · Bristol · Belfast · Plymouth

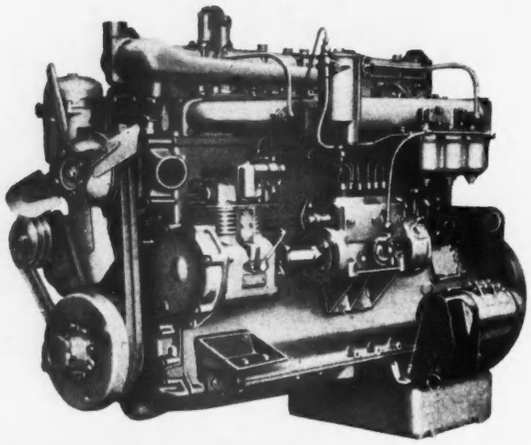
Enter No. 1431 on reply card

The Sequel to 30 YEARS OF DIESEL SPECIALISATION

For thirty years Leyland have concentrated their efforts on perfecting the diesel engine. Today they can claim with confidence that no other engine of this type embodies so much experience, skill and craftsmanship in both design and construction—and yet sells at such a favourable price.

All Leyland engines—from 72 h.p. to 275 h.p.—have been developed with a background of experience in diesel engine power requirements for both transport and industrial applications. They are up to the minute in design...incorporate the latest metallurgical processes and are precision-built to the highest standards known in automobile engineering.

The economy and long life of the Leyland engine is proverbial. Working non-stop at rock-bottom fuel cost it rarely needs an overhaul before completing the equivalent of a quarter-million miles. But when it *is* needed, Leyland spares and service organisation is always on hand—at any time in any place.



Leyland ENGINES

The greatest moving force in industry

FROM 72 TO 275 H.P.

LEYLAND MOTORS LTD. · LEYLAND · LANCS SALES DIVISION: HANOVER HOUSE · HANOVER SQ. · LONDON W.I.

Enter No. 1441 on reply card

O and M + M. I. L

Organisation and Methods—the mid-century science of ironing out the kinks in the production line.

Practical engineers, well versed in machine shop routine from experience and knowledge gained over many years ironing out the kinks in the production line.

= IMPROVED EFFICIENCY

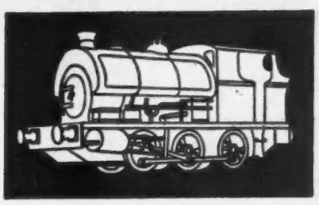
TELEPHONE: BIRMINGHAM MIDLAND 5731 P.B.E.
CARDIFF 25471 GLASGOW CITY 6597
NEWCASTLE UPON TYNE 22336

MACHINERY INSTALLATIONS LTD
60a HIGH STREET, ACTON, LONDON, W.3 phone: ACOrn 6044 P.B.E.

Enter No. 1451 on reply card

PECKETT

Locomotive and General Engineers



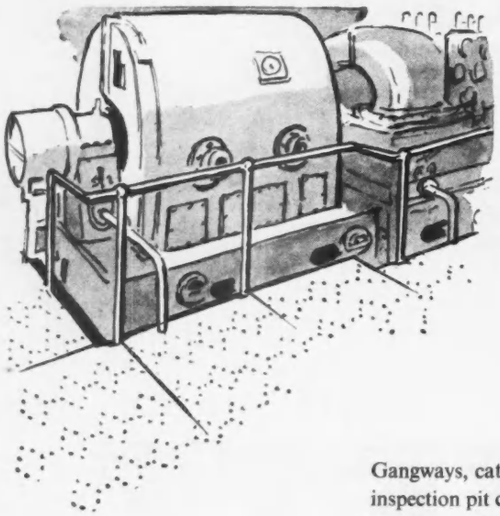
Development and Prototype work undertaken

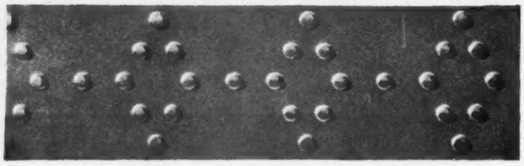
PECKETT & SONS LTD. Atlas Locomotive Works, ST. GEORGE, BRISTOL, 5.
Telegrams PECKETT BRISTOL Telephone BRISTOL 65-5346

London Representatives: Ferguson, Palmer & Kefford, Locomotive House, Buckingham Gate, London, S.W.1. Tel: VICtoria 5278/9

Enter No. 1452 on reply card

put it there





Gangways, catwalks, inspection pit covers, machine and turbine surrounds are just a few examples of the thousand and one industrial uses for Birmetals aluminium alloy treadplate. Non-magnetic, non-skid and non-sparking, this intrinsically safe material also combines structural strength with very light weight. And its natural resistance to corrosion means that you can rely on it having a long life.

Would you like further details?

BM235

Birmetals

Corrosion-resisting aluminium alloys

BIRMETALS LIMITED
WOODGATE WORKS · BIRMINGHAM 32

Enter No. 1461 on reply card

CLASSIFIED ADVERTISEMENTS

AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS

Lineage Rate. 4/- per line of approximately 6 words. Minimum 16/-.

Inch Rate. 48/- per single column inch and pro rata. 12 lines to 1 inch. There are reduced rates (i.e., not on a pro rata basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

AUCTION SALES · FOR HIRE · MACHINERY, etc., WANTED · SITUATIONS WANTED DRAWING AND DESIGN SERVICES · FOR SALE · SUB-CONTRACTING

Lineage Rate. 3/6 per line of approximately 6 words. Minimum 14/-.

Inch Rate. 42/- per single column inch and pro rata. 12 lines to 1 inch. There are reduced rates (i.e., not on a pro rata basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £22. ½-page £41 10s. Full page £78.

Series Discounts. For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/- which includes forwarding of replies.

Copy Dates. "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to*—Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

Urgent advertisements may be telephoned to CENtral 6565

PUBLIC APPOINTMENTS

COUNTY BOROUGH OF DONCASTER EDUCATION COMMITTEE

DONCASTER TECHNICAL COLLEGE

Principal: W. LOMAX, M.Eng., B.Sc., A.M.I.Min.E.

LECTURER

Applications are invited for the post of LECTURER in the Mechanical Engineering Department, to teach one or more of the following subjects to Higher National Certificate level:—

Theory of Machines, Strength of Materials, Theory of Structures, Applied Thermodynamics.

Applicants should possess a University Degree or equivalent, with suitable industrial and teaching experience. Associate Membership of an appropriate professional institution would be an advantage.

Salary for this post will be in accordance with Burnham (Technical) Scales (£1370–£1550). Commencing salary will be dependent on industrial and teaching experience. Duties to commence 1st January, 1960.

Application forms may be obtained from the undersigned and should be completed and returned as soon as possible.

V. H. HOSKIN,
Chief Education Officer,

Education Offices,
Whitaker Street,
Doncaster. E7483

ROYAL AIRCRAFT ESTABLISHMENT TECHNICAL COLLEGE

FARNBOROUGH, HANTS.

SENIOR LECTURER IN AIRCRAFT STRUCTURES

Applications invited for post of SENIOR LECTURER IN AIRCRAFT STRUCTURES, to teach subject for final B.Sc. (Eng.), Dip. Tech. and A.F.R.Ae.S.

University Degree or equivalent, and preferably some industrial and/or teaching experience required. Facilities for research available. Duties to commence on or before 1st January, 1960.

Burnham Scale for Technical Colleges: £1550 by £50 to £1750.

Application forms from Principal of College, for return within 14 days. E7465

NORTH RIDING EDUCATION COMMITTEE

CLEVELAND TECHNICAL COLLEGE, REDCAR

HEAD OF THE ENGINEERING DEPARTMENT

Applications are invited for the post of HEAD OF THE ENGINEERING DEPARTMENT (Grade I), to take effect from January 1, 1960. Vacancy caused by promotion. Candidates should have a Degree, or equivalent qualification, in Mechanical Engineering, and have suitable teaching and industrial experience.

Forms and particulars obtainable from me on receipt of stamped, addressed envelope. Completed forms to be returned on or before 13th October, 1959. E7485

READING TECHNICAL COLLEGE

DEPARTMENT OF ENGINEERING

LECTURERS

Applications are invited for the following 3 posts of LECTURER: (1) Electrical Engineering (Light Current); (2) Electrical Engineering (General); (3) Mechanical Engineering (Metallurgy). Degree or equivalent professional qualification, good industrial experience and teaching experience essential. Salary: £1370–£1550.

Application forms (returnable by 14th October) and further particulars obtainable from the Principal, Reading Technical College, King's Road, Reading. E7486

PUBLIC APPOINTMENTS

UNIVERSITY OF LONDON KING'S COLLEGE

LECTURER IN ELECTRICAL ENGINEERING

The College will require on 1st January, 1960, or as soon after as possible, a LECTURER IN ELECTRICAL ENGINEERING. Honours degree essential. Principal requirement an ability to teach rotating machine theory and design; an interest in servo-mechanisms an advantage.

Salary scale: £900 by £50 p.a. to £1350; then, after review, by £75 p.a. to £1650. Starting point according to age and experience. In addition a London allowance, family allowances and F.S.S.U. benefits will be payable.

Full conditions of appointment and application forms may be obtained from the Registrar, King's College, London, Strand, W.C.2; completed forms must reach him by October 31st. E7502

BUILDING RESEARCH STATION (D.S.I.R.)

GARSTON, NR. WATFORD, HERTS.

ENGINEER AND PHYSICIST

ENGINEER and PHYSICIST required at Building Research Station (D.S.I.R.), Garston, Nr. Watford, Herts, as follows:

STRUCTURAL or CIVIL ENGINEER with scientific outlook, to work on research projects relating to nuclear power stations, multi-storey buildings, lightweight reinforced concrete or ultimate strength design. Work includes laboratory investigations, field studies and collaboration with engineering consultants and contractors. (Ref. E239/8A.)

PHYSICIST for basic research in heat transfer/aerodynamic/convection processes defining the microclimate in buildings. (Ref. A139/8A.)

Qualifications for each post: 1st or 2nd Class Hons. Degree. (At least 3 years' post-graduate experience required for S.S.O.)

Salary ranges: Scientific Officer (Men), £615–£1090 (Post-graduate experience and National Service considered in assessing starting salary). Senior Scientific Officer (£1166–£1380). Excellent prospects of advancement.

Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1 (quote reference). Closing date: 23rd October, 1959. E7494

TEES VALLEY AND CLEVELAND WATER BOARD

LARTINGTON FILTRATION WORKS

APPOINTMENT OF RESIDENT ENGINEER

The Board invites applications for the appointment of a RESIDENT ENGINEER—Lartington Filtration Works, at a salary within the range of Grade A.P.T.V. of the National Salary Scales (£1220–£1375) depending upon qualifications and experience of the applicant.

Applicants should be Corporate Members of the Institution of Civil Engineers and have had a sound technical and practical experience in the design and construction of water retaining structures and building work including supervision of contracts.

The person appointed to the post will be responsible for the supervision of works carried out by contract; for the execution of such works in accordance with the designs and specifications prepared by the Board; for the interpretation of such designs and specification; and the carrying out of additional and/or amended design work on site under the direction of the Board's Engineer, New Works, &c.

The appointment will be for the duration of approximately 2–3 years and the successful candidate must devote his whole time to the work of the Board and will be required to pass a medical examination. The appointment will be subject to the provisions of the Local Government Superannuation Acts, 1937–1953.

Applications endorsed "Resident Engineer—Lartington Filtration Works," stating age, qualifications and experience, accompanied by three recent testimonials, must reach the undersigned by Monday, 19th October, 1959.

E. A. MORRIS,
Clerk of the Board and
Chief Executive Officer.

Water Board Offices,
Corporation Road,
Middlesbrough. E7453

PUBLIC APPOINTMENTS

HORNCHURCH URBAN DISTRICT COUNCIL

SEWAGE DISPOSAL WORKS—CONTRACT NO. 3

APPOINTMENT OF RESIDENT ENGINEER

Applications are invited for the above appointment, to supervise the construction of extensions to the Sewage Disposal Works, comprising biological filters, humus tanks, sludge digestion tanks, drying beds, pipework, administration building and additional pumping plant. The work will be executed by contract and will be under the supervision of the Consulting Engineers, Messrs. J. D. and D. M. Watson, M.I.C.E., 67, Tufton Street, London, S.W.1.

The salary offered is £1300 a year. Subject to satisfactory service, the appointment is expected to last for about 2 years and will be terminable by one month's notice on either side.

Applicants should apply in writing to the undersigned not later than Monday, 12th October, giving full particulars of age, qualifications and experience, together with the names of at least two referees who would testify to character and ability.

P. L. COX,
Clerk of the Council.

Council Offices,
Hornchurch,
Essex.
September, 1959. E7470

SOUTH WEST SUBURBAN WATER COMPANY

ASSISTANT ENGINEER

Applications are invited for the above vacancy in the Chief Engineer's Department.

Candidates should be about 26 years of age and have passed the Professional Interview of the Institution of Civil Engineers' examination or the equivalent thereof. They must have had at least 4 years' experience in the water, municipal or civil engineering industries.

Duties will be to assist in the day-to-day running of the undertaking and, in particular, with filtration problems. At present treatment of Thames water is by sedimentation followed by rapid gravity and slow sand filtration. The person appointed will help to develop a method of treatment permitting slow sand filtration to be discontinued. New works to be put in hand shortly include a 3 M.G. service reservoir, electrification of engine house, new river intake and numerous main extensions. The Company serves an area of 100 square miles with a population of 200,000.

The salary offered is upwards of £900 p.a., according to qualifications and experience.

The appointment, which is subject to medical examination, is permanent and pensionable. There are prospects of promotion.

Applications, stating age, qualifications and experience, should be sent to the Chief Engineer, The Causeway, Staines, Middlesex, by October 10th, 1959.

J. R. BROCK GRIGGS,
B.Sc., A.M.I.C.E., M.I.W.E.,
Chief Engineer.

E7385

THURROCK URBAN DISTRICT COUNCIL

ENGINEER AND SURVEYOR'S DEPARTMENT

APPOINTMENTS

Thurrock Urban District Council (population 105,000—rapidly increasing) (Engineer and Surveyor's Department) require (a) ASSISTANT ENGINEER. Salary, A.P.T. IV, £1065–£1220 p.a. Applicants should be Chartered Civil or Municipal Engineers, or have equivalent qualifications, and have extensive civil engineering experience, and be capable of designing and supervising construction of major schemes. In particular, experience is desired in sewerage and sewage disposal. Housing accommodation may be considered if successful candidate resides more than 20 miles from Thurrock. (b) TWO ENGINEERING ASSISTANTS. Salary, A.P.T. I/II, £610–£880 p.a. Applicants should have completed their training in a Municipal or Civil Engineer's Office and have had some subsequent experience. Appointments pensionable.—Applications, stating age, qualifications and experience, and quoting three referees, to the Clerk of the Council, Council Offices, Grays, Essex, by 6th October, 1959. Canvassing disqualifies. Relationship with members or senior officers of the Council must be disclosed. E7395

PUBLIC APPOINTMENTS

ATHERSTONE RURAL DISTRICT COUNCIL

DISTRICT WATER SUPPLY—CONTRACT NO. 2

APPOINTMENT OF RESIDENT ENGINEER

Applications are invited for the above appointment, to supervise the following works, under the direction of the Council's Consulting Engineers, J. D. and D. M. Watson, MM.I.C.E., Chartered Civil Engineers, 67, Tufton Street, Westminster, S.W.1.

The construction of one 42,000 gallon reinforced concrete reservoir, one new building and extensions and alterations to one existing building to house treatment plant, one booster station, the sinking of one borehole and the cleaning out and lining of two existing boreholes, the installation of two water treatment plants, three automatic electrically controlled submersible borehole pumping sets and booster plant, and the construction of about 14½ miles of asbestos cement mains, including fittings and service connections.

The salary offered is £1200 per annum and the appointment will be terminable by 2 months' notice on either side and will be subject to satisfactory service.

It is expected that the works will commence during December, 1959, and will take 18 months to complete.

A car mileage allowance will be paid on the Essential User scale.

Applicants, who should be Associate Members of the Institution of Civil Engineers, or have comparable qualifications, and must have had experience of similar work, should apply in writing to the undersigned not later than 26th October, 1959, giving full particulars of age, qualifications and experience and enclosing copies of not less than two recent testimonials.

G. CARLYON MAY,
Clerk of the Council.

Council Offices,
Atherstone,
Warwickshire,
September, 1959. E7467

GOVERNMENT OF HONG KONG

PUBLIC WORKS DEPARTMENT

ELECTRICAL ENGINEER

Duties involve planning, estimating and erection of complete electrical installations in large buildings, hospitals, &c., including H.T. and L.T. switchboards, transformers, lifts, pumps, electro-medical apparatus, &c.

Contract appointment for 3 years with prospect of permanency. Salary: £1245–£2178, plus cost-of-living allowance and gratuity. Rented quarters. Free passages.

Candidates must be A.M.I.E.E. and preferably under 35 years.

Write, Director of Recruitment, Colonial Office, London, S.W.1, giving full names, age, qualifications and experience quoting BCD 112/51/012/D4. E7496

ARCHWAY GROUP HOSPITAL MANAGEMENT COMMITTEE

WHITTINGTON HOSPITAL, N.19

ASSISTANT ENGINEERS

ASSISTANT ENGINEERS required at Whittington Hospital, N.19. Applicants over 25 years of age preferred, who should have completed practical training in mechanical engineering. Ordinary National Certificate for Mechanical Engineering or equivalent an advantage. Salary scale: £545–£670 per annum, plus London Weighting at 26 or over. Successful candidate will be required to reside within reasonable distance of hospital. Department may be visited by direct appointment with Hospital Secretary, ARC.3070, Ext. 254.

Application forms obtainable from and returnable to Group Secretary, 46, Cholmeley Park, N.6, by 12th October, 1959. E7472

Classified Advts. continued on page 148

PUBLIC APPOINTMENTS

ADMIRALTY

CONSTRUCTION DIVISION OF SHIP DEPARTMENT, ADMIRALTY, BATH

VENTILATION ENGINEERS

Admiralty require qualified VENTILATION ENGINEERS for Construction Division of Ship Department, Admiralty, Bath. British subjects and qualified for Corporate Membership of Institution of Mechanical Engineers, or have evidence of ability to secure membership within probationary period, together with Corporate Membership of Institution of Heating and Ventilation Engineers or Diploma of National College of Heating, Refrigeration and Fan Engineering, covering following subjects :—

AIR CONDITIONING and VENTILATION ; FAN ENGINEERING ; REFRIGERATION APPLICATIONS ; MECHANICS OF FLUIDS ; HEAT TRANSFER ; MATHEMATICS.

Applicants should be familiar with complete design of air conditioning systems and selection and installation of suitable equipment. Some experience in ship installation an advantage. Probationary period for first six months, after which, if services are satisfactory, will be considered for permanent and pensionable employment. Salary on entry in range £805 to £1260, and exceptionally up to £1730, depending on age, qualifications and experience. Annual increases for satisfactory service and opportunities for promotion.

Forms from M.L. and N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting C.629/9A. Closing date : 30th October, 1959. E7466

GHANA PUBLIC SERVICE COMMISSION

GHANA RAILWAY

ENGINEER (HARBOUR BRANCH)

Applications are invited for the post of ENGINEER (HARBOUR BRANCH), Ghana Railway.

Duties : Responsible to the Port Authority for maintenance of wharves, breakwaters, buildings, railway tracks and all other civil engineering installations in Tema Harbour area as well as for new works.

Qualifications : 1. Candidates must : (a) hold a B.Sc. (Eng.) or other recognised engineering degree and must have gained not less than two years practical post-graduate experience ; or (b) being not less than 23 years of age, have passed Parts I and II of the examinations of the Institution of Civil Engineers. 2. Candidates must also have obtained not less than 3 years practical experience on harbour works after qualifying in terms of (a) or (b) of paragraph 1 above. Salary range £1080–£2080.

Appointment on contract/gratuity terms for two tours each of 15–18 months in the first instance. Gratuity at rate of £12 10s. for each completed month of service. Free passages for officer, wife and up to 3 children under 18 years and in addition an education allowance for children when not resident in Ghana of £100 a child for up to 3 children under 18 years. Outfit allowance £60/£30. Accommodation at low rental. Interest-free advance for car and car maintenance allowance. Generous home leave on full pay. Income tax at low local rates. Preservation of superannuation or pension rights, where applicable, may be arranged.

For further particulars and application forms write, stating age, qualifications and experience, to The Director of Recruitment, Ghana High Commissioner's Office, 13, Belgrave Square, London, S.W.1. E7422

TENDERS

INDIA SUPPLY MISSION

WASHINGTON, D.C.

The India Supply Mission, Washington D.C., invites TENDERS for the supply of :

Sl. No.	Description of Equipment	Enquiry No.	Closing Date
1	Packing for distillation Column	SE-81	17th Nov., 1959
2	Drying Oven and Dryer	SE-84	17th Nov., 1959
3	Filters and Magnetic Traps	SE-89	19th Nov., 1959
4	Crucible for catalyst recovery	SE-91	17th Nov., 1959
5	Fermenters	SE-100	24th Nov., 1959
6	Ion exchange column for streptomycin extraction	SE-101	24th Nov., 1959

Forms of Tender may be obtained from the India Store Department (C.D.N. Branch), Government Building, Bromyard Avenue, London, W.3, upon a payment of a fee of 21s. 6d. per Tender, which is not returnable. The relevant enquiry No. and Ref. No. S.3624/59 (C.D.N.) must be quoted in all applications. E7490

MADRAS PORT TRUST

MADRAS, INDIA

The Office of the Chief Engineer, Madras Port Trust, Madras, India, invites TENDERS for the following :

TENDER ENQUIRY No. B/21880/59/E.P.

For the Supply of GALVANISED STEEL LINK CHAINS for Fenders in different lengths 230 Nos.

Specifications, drawings, &c., relative to the above can be obtained direct from the Deputy Chief Accounts Officer (Engineering), Chief Engineer's Office, Madras Port Trust, Madras, India, on payment of 7 shillings and 6 pence per set, which is not refundable. Tenders are to be returned direct to the Chief Engineer's Office (at "C" Warehouse), Madras Port Trust, Madras, India, so as to reach them by 2.30 p.m. on 3rd November, 1959.

Specimen copy of the above Specification can be seen at "India Store Department," Engineering Branch, Government Building, Bromyard Avenue, Acton, London, W.3, under reference S.3597/59/NSC/ENG.2. E7491

TENDERS

DUNMOW RURAL DISTRICT COUNCIL

WILLOWS GREEN AND CAUSEWAY END, FELSTED

SEWERAGE AND SEWAGE DISPOSAL

CONTRACT NO. 14

Tenders are invited on a fixed price basis in accordance with the Ministry of Housing and Local Government Circular No. 31/57 for the construction of SEWERAGE AND SEWAGE DISPOSAL WORKS at Willows Green and Causeway End.

The Sewage Disposal Works to be constructed at Willows Green will comprise a pyramidal sedimentation tank, biological filter, pyramidal humus tank, concrete sludge digestion tank, sludge drying area, stormwater irrigation area, pumping station in reinforced concrete, ancillary pipework, access road and paths.

The Sewerage in Willows Green and Causeway End comprises in all the laying of about 2400 linear yards of 9in. diameter S.G.W. sewer, 2300 linear yards of 6in diameter S.G.W. sewer, together with 4in. and 6in diameter S.G.W. house connections and the construction of 13 brick and 38 precast concrete manholes.

General Conditions of Contract, Specification, Bills of Quantities and Drawings may be obtained from the Council's Consulting Engineers, Messrs. J. D. and D. M. Watson, MM.I.C.E., 67, Tufton Street, Westminster, S.W.1, on and after 5th October, 1959, on payment of a deposit of ten guineas, refundable only to Contractors who submit bona fide tenders and return all documents and drawings. Deposit cheques should be made payable to Dunmow Rural District Council.

The Council do not bind themselves to accept the lowest or any tender.

Tenders must be returned in envelopes which do not bear any name or mark indicating the sender, endorsed "Tender for Sewerage Contract 14" and delivered at the office of the undersigned by noon on 13th November, 1959.

A. H. BURTON,
Clerk of the Council.

Council Offices,
Dunmow, Essex. E7423

NATIONAL COAL DEVELOPMENT CORPORATION, LTD.,

DARBHANGA HOUSE, RANCHI, INDIA

The Office of the National Coal Development Corporation, Ltd., Darbhanga House, Ranchi, India, invites TENDERS for the following :

TENDER ENQUIRY No. CPO/L-11/87-R.

(a) For the supply of Cables, Pumps, Oil Circuit Breakers, Transformers, Transwitch, Belt Vulcaniser and Fastening Machine, Insulation Testing Megger, Tong Testing Ammeter, Earth Continuity Tester

TENDER ENQUIRY No. CPO/C-1/88-R.

(b) Trailing cables, underground cables for Telephone, Cable Vulcaniser, Anemometer, Lightning arrestor, Haulage and Steel Wire Ropes, &c.

Specifications, &c., relative to the above specifications can be obtained from the office of the Chief Purchase Officer, National Coal Development Corporation, Ltd., Darbhanga House, Ranchi, India, or 1, Council House Street, Calcutta-1, India, on production of a Cash receipt of Rs. 10—i.e. 15 shillings per set per Tender enquiry—(not refundable) to be deposited with the Cashier, Chief Accounts Officer's Office, National Coal Development Corporation, Ltd., Darbhanga House, Ranchi, India, or 1, Council House Street, Calcutta, India. Neither cheque nor postal orders will be accepted towards the tender fee. Tenders are to be returned to the Chief Purchase Officer, National Coal Development Corporation, Ltd., Darbhanga House, Ranchi, India, so as to reach them by 3 p.m. on 3rd November, 1959 for (a), and 3 p.m. on 2nd November, 1959, for (b).

Specimen copy of the above enquiries can be seen at India Store Department, Engineering Branch, Government Buildings, Bromyard Avenue, Acton, W.3, under the following reference S.3592/59/NSC/ENG.2. E7492

KINGDOM OF THAILAND

ROYAL IRRIGATION DEPARTMENT, BANGKOK, THAILAND

INVITATION FOR BIDS— NO. YS-4-7

STEEL REINFORCEMENT BARS

The Royal Irrigation Department of the Kingdom of Thailand hereby invites sealed written BIDS for FURNISHING and DELIVERY, either f.o.b. Contractor's shipping point or c.i.f. Bangkok Wharf, Kingdom of Thailand for the Yanhee Multi-purpose Project in accordance with the Contract Documents, Invitation for Bids No. YS-4-7, the following materials :

2240 metric tons of STEEL REINFORCEMENT BARS, of selected diameter, to American Society of Testing Materials Standards, or equivalent, and to lengths of approximately 12 metres.

Bids will be opened at 10 a.m., 1st December, 1959. Copies of Contract Documents, Invitation for Bids YS-4-7 may be obtained by qualified Bidders on written request on Bidder's letterhead, addressed to :

Royal Irrigation Department, Attention : Thai Liaison Engineer, c/o Engineering Consultants, Inc., 1940 West Mississippi Avenue, Denver 23, Colorado.

Each request must be accompanied by a cheque or money order made payable to the Royal Irrigation Department in the amount of U.S. $5.00 for each copy of the Contract Documents requested. The remittance is non-returnable.

M. L. XUJATI KAMBHU,
Director-General,
Royal Irrigation Department.

Kingdom of Thailand,
Bangkok, Thailand. E7489

KINGDOM OF THAILAND

ROYAL IRRIGATION DEPARTMENT, BANGKOK, THAILAND

INVITATION FOR BIDS No. YSC-3-1

230kV BANGKOK TRANSMISSION TIE LINES

The Royal Irrigation Department of the Kingdom of Thailand hereby invites sealed written BIDS for FURNISHING, TRANSPORTING, HANDLING, CONSTRUCTING and ERECTING of 230kV single circuit and double circuit transmission lines in, and in the vicinity of, Bangkok, Thailand, for the 230kV Transmission System, Yanhee Multi-purpose Project, Kingdom of Thailand, in accordance with the Contract Documents, Invitation for Bids No. YSC-3-1. A brief description of the work is as follows :

Perform the complete Construction, Erection and Furnishing of all materials for approximately 18·5 kilometres (11·5 miles) of single circuit transmission line, 13·1 kilometres (8·1 miles) of double circuit transmission line with only one circuit installed, and 4·4 kilometres (2·8 miles) of double circuit transmission line with both circuits installed. The Contractor will be required to design and furnish 230kV steel single circuit and 230kV steel double circuit transmission line towers, and to furnish 1,272,000 circular mil ACSR conductor (42/7 strand), 9·525 millimetres (⅜ inch) extra high-strength steel overhead ground wire (7-strand), conductor and ground wire accessories, transmission line insulators and insulator hardware, and tower grounding materials.

Invitation for Bids will be issued in early October, 1959. It is the intention to include in this invitation, by supplemental notice, 270 miles of double circuit 230kV transmission line from Bangkok to Bhumiphol Power Plant if survey data is complete in time. If time does not permit this action, a second invitation will be issued for this double circuit line on the same basis as for the Bangkok Tie Lines, that is, on a furnish and install basis. Copies of Contract Documents, Invitation for Bids—YSC-3-1, may be obtained by qualified Bidders on written request on Bidder's letterhead, addressed to :

Royal Irrigation Department, Attention : Thai Laison Engineer c/o Engineering Consultants, Inc., 1940, West Mississippi Avenue, Denver 23, Colorado.

Each request must be accompanied by a cheque or money order, payable to the Royal Irrigation Department, in the amount of U.S. $10·00 for each copy of the Contract Documents requested. The remittance is non-returnable.

M. L. XUJATI KAMBHU,
Director-General,
Royal Irrigation Department.

Kingdom of Thailand,
Bangkok, Thailand. E7478

INDIA STORE DEPARTMENT

ALUMINIUM ALLOY ROUND BARS

Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for :—

ALUMINIUM ALLOY ROUND BARS to B.S. Specification. 29 tons approximately.

Forms of Tender may be obtained from the above address at a fee of 10s., which is not returnable.

If payment is made by cheque, it should be made payable to "High Commission for India." Tenders are to be delivered by 2 p.m. on 12th November, 1959.

Please quote reference No. 11/59/Rly.1. E7476

COQUET WATER BOARD

WARKWORTH INTAKE WORKS

Civil engineering contractors are invited to TENDER for the construction of the intake works on the River Coquet near Warkworth which comprise :

A pool type reinforced concrete FISH PASS at Coquet Lodge Weir, 300ft. long and 15ft. wide, founded on piles, which embodies the main intake itself and a recirculation water outfall ;

A RECIRCULATION WATER INTAKE at a point some ½-mile downstream ;

A 30in. RECIRCULATION WATER PIPELINE about ½ mile long ;

The erection of a CONTROL GATE on an existing fish pass ;

TWO PONDING WEIRS about 200ft. long, in the River Coquet downstream of the recirculation water intake.

Tender documents will be ready for issue towards the end of October and the tenders will be returnable towards the middle of December. Contractors who are desirous of tendering should send an application with a deposit of £5 to the Engineers : Sir William Halcrow and Partners, 47, Park Lane, London, W.1.

The deposit will be returned on receipt of a bona fide tender.

The Board is not bound to accept the lowest or any tender.

F. G. EGNER,
Clerk and Solicitor.

The Coquet Water Board,
14, Northumberland Square,
North Shields. E7459

INDIA STORE DEPARTMENT

STEEL BARS COLD DRAWN

Director General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites TENDERS for :—

STEEL BARS COLD DRAWN. Reduction in Dia. Not to Exceed 0·015in. Finished Size 1·625in. plus-minus 0·003in. Quantity 195·37 Tons.

Forms of Tender may be obtained from the above address at a fee of 10s., which is not returnable.

If payment is made by cheque, it should be made payable to "High Commission for India." Tenders are to be delivered by 2 p.m. on 12th November, 1959.

Please quote reference No. 8/59/RLY.1. E7477

EDUCATIONAL

A.M.I.MECH.E., B.Sc., City and Guilds, &c. Guarantee Postal Courses for all Exams. and Technical Divisions from Elementary to Degree standard including Automation Techniques. Approximately 95 per cent. successes. 148-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 E

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES NOT ORIGINALS OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

ASSISTANT CHIEF DRAUGHTSMAN required by expanding Company in Surrey approximately 25 minutes from Waterloo. Successful applicant should be experienced in the design of small mechanisms, &c., be a good disciplinarian, and in view of the specialised nature of the product will be expected to make his career with the Company. Minimum qualification of H.N.C., but men with experience and a sound background who are not so qualified will be considered.—BOX No. E169, "The Engineer." A

BP invites applications from GRADUATES aged 23–26 years with an honours degree in Petroleum Engineering, Engineering or Physics, for employment as Assistant Production Engineers in Trinidad in the first instance. Duties will consist of assisting in all aspects of field production work, including well control, artificial lift, gas control, oil collection and well servicing. National Service obligations must have been fulfilled.—Write, stating age and full details of qualifications and experience, quoting F.574A, to Box 3181, c/o 191, Gresham House, E.C.2. E7500 A

BRITISH INDUSTRIAL SAND, LTD., High Street, Godstone, Surrey. DRAUGHTSMEN required by rapidly expanding Quarrying Organisation, O.N.C. or H.N.C. Mechanical Engineering an advantage, for work on mechanical handling, conveying plant, structures, &c. Site visiting would be included in duties. Excellent prospects for the right men. There is a Staff Pension Scheme in operation. E161 A

BRITISH WATERWAYS require DIVISIONAL ENGINEER for North Western Division (office at Liverpool). Applications are invited from Corporate Members of the Institution of Civil Engineers ; salary range £2025–£2450 per annum. Candidates should have wide experience in the design, construction and maintenance of inland waterway and marine works. If eligible, will be required to join contributory superannuation scheme. Certain privilege rail travel available.—Applications, giving details of past experience to reach Staff and Establishment Officer, British Waterways, 163, Euston Road, London, N.W.1, by 15th October, 1959. E7462 A

DESIGN ENGINEERS H.N.C. (Min.) required. Experience in one or more of the following essential : Cranes, Excavators, Truck-mounted Mobile Cranes and Contractor's Plant. Good staff conditions. Pension scheme.—Applications in writing, all relevant particulars and approximate salary required to : Personnel Manager, Ruston-Bucyrus, Ltd., Excavator Works, Lincoln. E7473 A

ELECTRO-STATIC PRECIPITATION. Interesting offer to SENIOR ENGINEER with experience, full technical knowledge, capable initiating and controlling department to produce and sell Electro-Static Precipitators for all appropriate industrial applications.—Write stating age, qualifications, salary required, to BOX No. E7475, "The Engineer." A

ENGINEER with thorough knowledge of lubricants wanted. Good prospects for the right man. —Apply in writing to Managing Director, Snowdrift Lubricants, Ltd., 4, Chantrey House, Eccleston Street, S.W.1. E2560 A

ENGINEER, MECHANICAL. Supervision of general maintenance, erection and dismantling Plant, &c. State salary and experience in writing to Rees Industries, Ltd., Great Western Dock, Llanelly. E2557 A

ENGINEERS for overseas pipeline contracts required immediately. Young men with experience of design, construction, supervision or planning and estimating in this field are offered excellent opportunities with this company.—Apply in first instance in writing to Collins Submarine Pipelines, Ltd., 18, Park Street, London, W.1. E2556 A

FLUIDRIVE ENGINEERING CO., LTD., Fluidrive Works, Worton Road, Isleworth, Middlesex, require DESIGN AND DETAIL DRAUGHTSMEN experienced in power transmission work. H.N.C. standard preferred. Good salary and conditions.—Write Chief Designer.

E7446 A

JUNIOR ENGINEERING DRAUGHTSMAN

required by the National Coal Board at London Headquarters. Applicants should have completed an Engineering Drawing Office apprenticeship in mechanical engineering. Draughtsmanship must be of a high standard and a minimum qualification of O.N.C. or equivalent is desirable. Appointment superannuable, salary according to qualifications and experience within £607–£764.—Write for application form to Staff Dept. (X1568.B), N.C.B., Hobart House, London, S.W.1, which should be returned by 12th October, 1959.

E7484 A

MECHANICAL ENGINEER, with some electrical knowledge, required to join a group engaged on design and site supervision of oil products pipeline and distribution depots in Iran. Knowledge of petroleum practice is essential. Applicants should be aged about 35 years and have design experience of pumping and ancillary equipment. Applicants will be required to work in London in the first instance.—Send fullest particulars to Staff Office, Rendel, Palmer and Tritton, Consulting Engineers, 125, Victoria Street, S.W.1. E7392 A

SITUATIONS VACANT

INSTRUMENTATION ENGINEER
BRITISH NYLON SPINNERS

invite applications from a GRADUATE in Mechanical or Electrical Engineering to fill a vacancy in their head office.

Candidates between 28 to 35 years of age, should have had experience in the investigation, design and application of industrial instrumentation, including pneumatic and electrical control gear.

This appointment offers a progressive and satisfying career to a man who is keen to apply his knowledge to design and installation problems, and to follow a project through to its completion.

Prospects are good. A contributory pension scheme is in operation, houses may be rented and removal expenses assisted.

Selected applicants will be invited to visit the Company, which is attractively situated, for a personal discussion.

Applications, quoting reference 2/E/17, should be made to the
Personnel Manager,
British Nylon Spinners, Ltd.,
Pontypool, Monmouthshire.

E7471 A

RESEARCH ENGINEER

with Honours degree, and experience in engine research and mathematical analysis, required for interesting investigations of mechanical and thermal stresses in pressure-charged diesel engines.

Salary up to £1600 a year according to qualifications and experience. Pension scheme.

Please apply in writing, giving age, education, training and experience, to :

Director of Research,
The British Internal Combustion Engine Research Association,
111–112, Buckingham Avenue,
Slough, Bucks.

E7468 A

SALES REPRESENTATIVE required for London area by old-established company ; good connections with Architects and Consulting Engineers, &c., essential ; covering ironwork and structural steelwork.—BOX No. E7454, "The Engineer." A

PRODUCTION ENGINEER required for large engineering works in Glasgow, to take control of Production Engineering Department. Fully experienced in manufacturing methods and rate-fixing, covering machining, fitting, fabricating and welding, as applied to medium/heavy engineering products. Must have held previous similar position. The preferred age is between 35 and 45, and a salary in the region of £2000 depending on qualifications is being offered.—Apply BOX No. E7455, "The Engineer." A

SAFETY OFFICER. A large Engineering firm specialising in the erection of heavy industrial plant and building and civil engineering construction requires the services of a SAFETY OFFICER. The post involves control of the accident prevention work on contract sites in the U.K. An engineering background is desirable and technical qualifications would be an advantage. Candidates should have had experience of safety work and must be fully acquainted with the application of the Factories Act and Statutory Regulations. Only candidates who can fulfil these requirements will be considered and a commensurate salary will be paid to the right man. An interview in confidence will be arranged with suitable candidates and full details of duties, responsibility, &c., will be explained. The post is superannuable. The successful candidate will operate from an office in the North of England, but travelling to sites is necessary. Please write full details.—BOX No. E7493, "The Engineer." A

SENIOR DESIGN ENGINEER, H.N.C. preferred, knowledge of hydraulics desirable and capable of designing, on own initiative, medium heavy machinery.—Apply Mr. Bedford, Chamberlain Industries, Ltd., Staffa Road, Leyton, E.10, Tel.: LEY 3678. E7371 A

SENIOR DETAIL DRAUGHTSMAN, O.N.C. (Min.) required. Experience in one or more of the following essential : Cranes, Excavators, Truck-mounted Mobile Cranes and Contractor's Plant. Good staff conditions, Pension scheme.—Applications in writing, all relevant particulars and approximate salary required to : Personnel Manager, Ruston-Bucyrus, Ltd., Excavator Works, Lincoln. E7474 A

SENIOR DRAUGHTSMAN required for Drawing Office Section engaged on the application of small diesel engines to marine propulsion. Experience on this type of work is essential and technical qualifications an advantage. This will be a secure and well-paid position with excellent conditions of service.—Apply in writing, giving full details to the PERSONNEL MANAGER, PETTERS, LTD., STAINES, MIDDLESEX. E7487 A

STEEL TUBES. WORKS MANAGER required essential qualifications being wide experience in practical and executive aspects. Must have experience in similar position and be first-class administrator. This is a responsible position and future prospects are excellent.—Apply in confidence to the Managing Director, The Phoenix Steel Tube Company, Ltd., Phoenix Street, West Bromwich. E7499 A

STRUCTURAL DESIGNER required for work on important and interesting structures of steel lattice construction. Qualifications at least to H.N.C. and good experience in steel construction essential. Age 23 to 27.—Apply, giving all details and salary required to Personnel Officer (Staff), British Insulated Callender's Construction Company, Ltd., 21, Bloomsbury Street, London, W.C.1. E7437 A

STRUCTURAL ENGINEERS, senior and junior, required for busy London office handling wide variety building schemes. Considerable scope for advancement available men of initiative.—BOX No. E7498, "The Engineer." A

TECHNICAL LIAISON OFFICER

required, with experience in publicity, knowledge of diesel engines, ability to write well. Duties : to prepare and demonstrate exhibits, write semi-technical articles, help to exploit patents.

Commencing salary up to £1200 p.a. according to qualifications and experience.

Please reply in writing, giving age, education, training and experience, to :

Director of Research,
The British Internal Combustion Engine Research Association,
111–112, Buckingham Avenue,
Slough, Bucks.

E7469 A

THE GENERAL ELECTRIC COMPANY, LIMITED
ENGINEER FOR OPERATIONAL RESEARCH

A graduate with honours qualifications is required to join an Operational Research Section in a heavy engineering works. Age 23–28.

Previous experience in this type of work is desirable, but not essential, and suitable training will be given if necessary. The appointment calls for initiative, tact and sound judgment.

The salary is excellent. Write stating details of career in chronological order and present salary to the Personnel Manager (KHD), The General Electric Company, Ltd., Erith, Kent.

E7461 A

WANTED, FIRST-CLASS SENIOR DESIGN DRAUGHTSMAN for firm of General Engineers in Bristol. Good knowledge of general engineering, with particular reference to pressure vessels and stainless steel fabrication. This will be a well-paid position for the top-class man.—BOX No. E164, "The Engineer." A

WANTED URGENTLY, Estimator for Materials Handling Bulk and Package, used to working on own initiative on preparation of project drawings and tenders. Residence in Nottingham. State age, experience and salary expected.—Apply BOX No. E2561, "The Engineer." A

QUALIFIED ELECTRICAL & MECHANICAL ENGINEER

Required to take charge of all service departments in works in MIDLANDS employing approximately 1500 people. Technical knowledge of foundry equipment an advantage, but previous experience of works administration essential. Successful applicant will be directly responsible to the Works Director. Commencing salary £2750 to £3000, with prospects of further advancement—age 35 to 45.

Write : BOX TE.258, c/o 191, Gresham House, E.C.2.

E7481 A

SENIOR MECHANICAL DESIGN ENGINEER

An Engineer with a degree or equivalent qualification is required to work alongside people engaged in materials research. His function will be the design of specialised materials and apparatus, the construction of mechanical and electro-mechanical devices, laboratory scale plant and neo-mechanisms.

This is an interesting appointment with good prospects with a Research Unit in a pleasant part of the Midlands.

Apply : BOX No. E7449, "The Engineer."

A

BOOKS and PUBLICATIONS

HMSO

The Lighting of Factories

by M. J. KEYTE, A.R.I.B.A., and H. L. GLOAG, A.A.Dip., A.R.I.B.A.

The second paper in the **Factory Building Studies** series. It surveys the principles of good lighting and discusses their practical application. Illustrated. **3s. 6d.** (*post 4d.*)

Research in 1958

Latest additions to the annual series of reports from the specialised organisation of the Department of Scientific and Industrial Research.

Building Research **Hydraulics Research**

Each 5s. 6d. (*post 5d.*)

From the Government Bookshops or through any bookseller

HMSO

Enter No. 1491 on reply card

"A complete library in two volumes . . ."

KEMPE'S ENGINEERS YEAR-BOOK

Edited under the direction of the Editor of "The Engineer"

1959 Edition price **82/6** *(plus postage 2/6)*

from technical booksellers or direct from the publishers

Kempe's Engineers Year-Book, 28 Essex Street, Strand, London, W.C.2
Telephone : CENtral 6565

Enter No. 1492 on reply card

FOR A GROUP ENGAGED IN

RESEARCH AND DEVELOPMENT

The following staff are required for the design and development of new machinery and processes :

(*a*) A MECHANICAL ENGINEER

to work on projects concerned with security printing and packaging. The appointment would interest a man with an Honours Degree or a good pass Degree and a few years' experience in an established experimental and testing department ; the scope for original thinking and the scientific approach is such that these qualifications are more important than experience of printing or allied machinery.

(*b*) A MECHANICAL DRAUGHTSMAN

to work on the same projects as in (*a*). O.N.C. is the minimum requirement and experience of printing or paper converting machinery would be an advantage.

(*c*) AN ELECTRONIC ENGINEER

to work on data processing and similar projects. The post offers the scope to interest a man with a Degree. H.N.C. is the minimum qualification and experience of pulse techniques is desirable.

(*d*) A DRAUGHTSMAN

to work on the document handling aspects of (*c*). O.N.C. and experience in the design and development of light electro-mechanical equipment are desirable.

(*e*) A METALLURGICAL CHEMIST

to fill a responsible position concerned with the production of printing plates by electro-forming and with technical developments in this field. Experience of electro-deposition processes is essential.

The starting salaries and prospects will be attractive to those in engineering and manufacturing industries. There is a non-contributory pension scheme, and housing loans are available after a qualifying period of service. Applicants, who should be below the age of 32 and be British by birth, should write, giving full details of their careers including age, education, technical qualifications and experience to :

THE STAFF MANAGER,
BANK OF ENGLAND PRINTING WORKS,
LANGSTON ROAD, LOUGHTON, ESSEX.

E7482 A

Classified Advts. continued on page 150

SITUATIONS VACANT

FOSTER WHEELER LIMITED, LONDON

require a

VESSEL ENGINEER

for one of their Specialist Groups. Applicants should have at least four years' experience in the design of pressure vessels and tanks and should be fully conversant with relevant American Design codes. Some experience in the manufacture of pressure vessels is desirable, but not essential.

Applicants should apply in writing, stating briefly age, qualifications and experience, to the Staff Manager, 3, Ixworth Place, London, S.W.3.

E7463 A

SITUATIONS VACANT

Plessey

CHIEF INSPECTOR

A Chief Inspector is required immediately for the Chemical and Metallurgical Division, Towcester, Northamptonshire.

Applicants should have an engineering background and technical qualifications to H.N.C. or Grad.I.Mech.E. I.E.E. standard. Familiarity with standard specifications and Ministry Inspection requirements, together with several years' practical inspection experience and a good knowledge of radio and electronic components are essential.

Pension and Life Assurance Benefit are provided, and the Division is rapidly expanding.

Please write to : The Regional Personnel Manager, The Plessey Company Limited, Wood Burcote Way, Towcester, Northants.

E7457 A

SITUATIONS VACANT

Prominent and established manufacturers in London of special purpose precision machinery expect shortly to be appointing a new

CHIEF INSPECTOR

Applications are invited for this extremely important position, which will carry senior executive status and will be remunerative accordingly. The successful candidate, who will take control of an Inspectorate staff running into three figures, will be aged around 40, with technical qualifications in Mechanical Engineering to B.Sc. level, backed by appreciable practical and administrative experience gained in an equivalent capacity in the Machine Tool industry or on a similar type product.

Applicants thus qualified should write in strict confidence, giving all relevant data as concisely as possible, to BOX No. E7497, " The Engineer."

A

CALTEX SERVICES LIMITED

have vacancies for

CHEMICAL AND MECHANICAL DESIGN ENGINEERS

Applications for these openings, with unique opportunities for career advancement, are invited from men with a University Degree, having had at least two or three years' experience since graduation in design problems related to Petroleum refining or heavy chemical process plant, the upper age limit being 35.

A good salary will be offered for these progressive positions in the field of oil refinery design engineering. Opportunities arise from time to time for transfers to Associated Companies overseas, there being a contributory pension plan, both here and abroad.

Please write under reference " LON," giving full particulars of age, qualifications and experience, to :—

THE MANAGER PERSONNEL,
CALTEX SERVICES, LIMITED,
CALTEX HOUSE,
1, KNIGHTSBRIDGE GREEN,
LONDON, S.W.1.

E7456 A

A.E.R.E. HARWELL

A PROFESSIONAL ENGINEER

is required to lead a team engaged on the design and specification of plant and equipment for particle accelerating machines and to follow the work through the detail design, manufacture, installation and commissioning stages. The machines are being built at Harwell for the NATIONAL INSTITUTE for RESEARCH in NUCLEAR SCIENCE.

Applicants should be Members of the Institution of Mechanical or Electrical Engineers, with several years' experience in the design of complex mechanical/electrical plant, and have the ability to lead a team of design and development engineers.

Salary, £1855–£2155. Housing and superannuation schemes.

Please send a POST CARD for details to the Group Recruitment Officer (5061/25), A.E.R.E., Harwell, Didcot, Berks.

E7451 A

SENIOR ESTIMATING ENGINEER

KELLOGG

INTERNATIONAL CORPORATION

OFFERS FIRST CLASS SALARY TO FIRST CLASS MAN . . . . .

. . . . . and the opportunity to work and to grow in a firm renowned throughout the oil refining and petrochemical field. Our staff enjoys the benefit of Kellogg's 50 years' accumulation of experience and " know-how " in this highly technical industry.

The man we seek should be capable of estimating the various categories of oil and chemical equipment and materials, and to produce competitive tenders for plants both here and abroad of considerable magnitude. An engineering degree will be an advantage. A background of quantity surveying will be useful if combined with broad experience in mechanical or chemical equipment. The position, which is permanent, offers real scope for a man of ability and initiative.

Fringe benefits include Luncheon Vouchers, contributory pension scheme, sickness and life assurance and a Social Club.

Apply by letter only to Personnel Manager,

KELLOGG INTERNATIONAL CORPORATION,
7-10, CHANDOS STREET, CAVENDISH SQUARE, LONDON, W.1.
(Please quote reference 145/G.)

E7460 A

RTB

RICHARD THOMAS & BALDWINS LIMITED

have vacancies for

MECHANICAL ENGINEERS & DRAUGHTSMEN

at their

CENTRAL ENGINEERING DEPARTMENT

to be located at

SPENCER WORKS, LLANWERN, near NEWPORT, Mon.

The department is organised on a functional basis and responsibility is given within the following divisions :—

Iron & Steel : Hot & Cold Rolling : Processes & Finishing

Applications are invited for the following positions to assist in the design, development and layout of plant associated with the manufacture of Iron, Steel, Sheet, Tinplate and Finished Products at the works of the Richard Thomas & Baldwins Limited Group of Companies :—

PROJECT ENGINEERS · ASSISTANT ENGINEERS ENGINEERS · SENIOR DRAUGHTSMEN JUNIOR DRAUGHTSMEN

The range of specialisation is not rigid, but applicants should be trained and experienced in design and development work associated with modern Steelplant, Rolling Mills and Finishing Equipment or comparable installations in medium or heavy industrial engineering.
Salary scales commensurate with qualifications and experience. Contributory Staff Pension and Life Assurance Schemes.

Application form can be obtained by writing to :—

General Manager—Engineering. Richard Thomas & Baldwins Limited, Central Engineering Department, " Coed Parc," 42 Park Street, BRIDGEND, Glam.

Envelopes MUST be endorsed " MECHANICAL."

E7400 A

SITUATIONS VACANT

CENTRAL ELECTRICITY GENERATING BOARD

RESEARCH AND DEVELOPMENT DEPARTMENT

PHYSICS DIVISION

at the RESEARCH LABORATORIES, LEATHERHEAD, SURREY.

PHYSICISTS and MATHEMATICAL PHYSICISTS required for four vacancies as **SECTION HEADS** to supervise the work outlined below.

Candidates must possess a first or good second-class honours degree and should have had experience both of personal research in a relevant field and of control of laboratory staff.

(a) The HEAT TRANSFER section is occupied with a wide variety of heat transfer problems associated with conventional and nuclear power stations. There is ample scope for both fundamental and applied research.

(b) The FLUID FLOW section studies the behaviour of fluids with and without particles in suspension. It is concerned, for example, with particle transportation and precipitation, flow measurement, and aerodynamic and hydrodynamic models. The Section Head must be a competent aero- or hydro-dynamicist, and able to undertake both fundamental and applied research on such topics.

(c) The PHYSICAL METHODS section is responsible for the innovation and development of techniques of examination based on X-ray and electron diffraction, radiography, ultrasonics, radioactivity and other physical effects.

(d) The SOLID STATE section is a new one and the successful applicant will be required to take an active part in the recruitment of staff and in the formulation of a research programme on such topics as dielectric conduction, refractory semi-conductor materials and high power semi-conductor devices.

Salaries will be on scales within the range £2160–£2960 p.a., according to duties and responsibilities.

Applications, stating age, qualifications, experience, present position and salary to the Personnel Officer, 24/30, Holborn, London, E.C.1, by 19th October, quoting Ref. ENR/379.

E7488 A

GRADUATE MECHANICAL ENGINEER

A large progressive Company in the Manchester area desires to recruit a Graduate MECHANICAL ENGINEER, preferably with 3–4 years' practical experience.

It is intended that the duties will initially comprise investigational work in relationship to Steam and Power distribution and efficiency. This will be followed by further investigational work on the efficiency of Mechanical Plant. Thereafter additional promotional prospects are envisaged.

Good commencing salary, employee benefit scheme.

Applications, giving details of age and experience should be addressed to BOX No. E7396, "The Engineer."

A

SITUATIONS WANTED

STRUCTURAL ENGINEER seeks appointment in Midlands area. Twenty-five years' experience in responsible positions, including Chief Draughtsman, Chief Designer, Technical Manager. Would consider any Senior position offering scope.—BOX No. E2544, "The Engineer." B

SALES ENGINEER, A.M.I.Mech.E., experienced —Diesels, Compressors and Blowers, seeks post where interest, enthusiasm and integrity will be rewarded.—BOX No. E2558, "The Engineer." B

ENGINEER (47), A.M.I.Mech.E. Experienced wide range engineering; Design; Development. Requires Senior Post Design, Estimating, or Contracts Dept.—Write BOX No. E2559, "The Engineer." B

MECHANICAL DESIGNER, A.M.I.Mech.E. (49), seeks senior Design and Development appointment where ideas, results and leadership are needed. First class academic qualifications and 25 years of varied practical experience in light and medium engineering.—BOX No. E2564, "The Engineer." B

FOR HIRE

BELLMANS MASTS FOR HIRE, to lift from 1 to 20 tons, 30ft. to 150ft. Blocks and tackle. Hand-operated winches. From £1 per day.—BELLMAN'S (Phone: SLOane 5259), Hobart House, Grosvenor Place, S.W.1. E103 g

SUB-CONTRACTING

CASTINGS.—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process; sample castings treated; A.I.D. approved. —Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex ('Phone, Byron 1178). E109 MW

KELLERING AND CAM PROFILING capacity up to 8ft. by 6ft. or 6ft. diameter.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Telephone: Knottingley 2743/4). E116 MW

PRATCHITT BROTHERS, LTD., Denton Iron Works, Carlisle, having well-equipped engineering shops and ironfoundry, invite enquiries for General Engineering, Structural and Platework, from firms wishing to have plant made to their own designs and specifications. E125 MW

MOBILE LIFTING SERVICES.—Lump sum or Hire Rate Quoted for any Lifting Work by Lorry-Mounted or Crawler Cranes, any size, any area.—TARSLAG, LTD., Rotherham 3235. E167 MW

PATENTS

THE PROPRIETOR of British Patent No. 590,586, entitled "IMPROVEMENTS IN HYDRAULIC POWER TRANSMISSION MEANS," offers same for Licence or otherwise to ensure its practical working in Great Britain.—Enquiries to Singer, Stern and Carlberg, Chrysler Building, New York, 17, New York, U.S.A. E7495 H

BUSINESS OPPORTUNITIES

REMPLOY SPONSORSHIP SCHEME.—Send for details which show an attractive proposition to manufacturers.—Write to the Managing Director, Remploy, Ltd., 25–28, Buckingham Gate, S.W.1, or telephone VICtoria 6621 (12 lines). E155 o

ADVERTISER, PRIVATE INVESTOR desires to purchase whole or part interest in concern under progressive management making annual net profit of £15/50,000.—BOX No. E163, "The Engineer." o

TO ENGINEERING GROUPS.—Ultra Modern Foundry producing HIGH-GRADE GREY IRON CASTINGS, capacity 200 tons weekly. Would consider amalgamation and/or co-operation. Asset value of freeholds and plant approximately £150,000/£200,000.—BOX No. E165, "The Engineer." o

ENGINEERS with capital willing to purchase controlling interest in Company manufacturing engineering specialities. Replies will be treated in strictest confidence. Reply.—BOX No. E7364, "The Engineer." o

BUSINESSES & PREMISES

COMPANY WITH FREEHOLD FACTORY AND PLANT carrying on business of Gear Cutting and Engineering in London area for sale due to ill-health of Proprietor.—Apply Alfred Laban, Son and Company, Chartered Accountants, 25–27, Oxford Street, London, W.1. E7480 L

AGENCIES

MANUFACTURERS seeking to increase their sales in Scotland may secure reliable agents by writing with particulars to the Secretaries of the Scottish Association of Manufacturers' Agents, who will advertise under a box number in the Association News Letter.—Write to Dept. E., Hourston MacFarlane and Co., 5, St. Vincent Place, Glasgow, C.1. E148 D

ENERGETIC, WELL-INTRODUCED ENGINEERING AGENTS required for Company specialised in flow control equipment in connection with Butterfly Valves and Louvre Dampers, for South Wales and the West, Scotland and Southern England.—Please reply to The D.E.V. Engineering Company, Ltd., 299, Chapeltown Road, Leeds, 7. E2563 D

MACHINERY Etc. WANTED

FOR EXPORT. Required S.H. 1000 to 1500kW MCR Steam Turbo-Alternator suitable for an electrical system of 400/440 Volts, 3-phase, 50 cycle, Steam conditions 150 p.s.i.g. at 380 deg. Fah. to operate on back pressure at 10 to 15 p.s.i.g., condition to be first class.—BOX No. E2562, "The Engineer." F

FOR SALE

600

DIESEL ENGINE DRIVEN ALTERNATOR SETS

500kW continuous 400V., 3-phase, 50 cycles, 4-wire BELLISS AND MORCOM/LANCASHIRE DYNAMO COMPANY Diesel Engine Driven Alternator Set, direct coupled at 375 r.p.m. and comprising 7-cylinder vertical engine complete with ancillaries and starting equipment. Direct coupled to alternator with switchgear.

Six 330kVA, 400/440V, 3-phase, 50 cycles, 4-wire self-contained RUSTON PAXMAN type 12RPH2/B.T.H. Diesel Engine Driven Alternator Sets, radiator fan cooled. Each on bedplate and direct coupled at 1000 r.p.m.; electric starting; standard ancillaries and switchgear.

Two 270kVA, 400/440V, 3-phase, 50 cycles, 4-wire MIRRLEES TL6/BRUSH Diesel Engine Driven Alternator Sets, direct coupled at 600 r.p.m.; standard ancillaries, starting equipment and switchgear. Reconditioned ready for work.

240kVA, 400/440V, 3-phase, 50 cycles, 4-wire DAVEY PAXMAN/METROPOLITAN-VICKERS Diesel Engine Driven Alternator Set, direct coupled at 600 r.p.m.; standard ancillaries, starting equipment and switchgear. Date, 1951.

234kVA, 400/440V, 3-phase, 50 cycles, MIRRLEES Type UA8/METROPOLITAN-VICKERS Diesel Engine Driven Alternator Set, mounted on baseplate and direct coupled at 500 r.p.m.; standard ancillaries, starting equipment and switchgear. Little used.

GEORGE COHEN,

SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
(Phone: SHEpherds Bush 2070.)
STANNINGLEY, Nr. LEEDS.
(Phone: Pudsey 2241.) E200 G

VALES PLANT REGISTER LIMITED

OFFER FOR IMMEDIATE SALE

CRANES

NEALS 1-ton "D" MOBILE, 30ft. Lattice, Ruston engine, Pneumatics. 1950. £750.
NEALS "N" 2-ton MOBILE, 24ft. Jib, Ruston engine, Pneumatics. £575.
NEALS "NM" 2-ton MOBILE, 35ft. Jib, Ruston engine, Pneumatics. £1450.
BUTTERS 3-ton Electric DERRICKS, 120ft. Jibs, S.L.I's. £1500 each.
MORGAN 5-ton Electric DERRICK, 120ft. Jib. £1450.
COLES THORNYCROFT 5-ton LORRY MOUNTED, 30ft. Jib, Rope, derricking. £2500.
JONES KL 66 6-ton, 30ft. Lattice, Perkins engine, on Pneumatics, Double Drum with 15/12 Grab, 1956. £4950. Available in 6-8 weeks.
BUTTERS 7-ton 2-motor Electric DERRICK, 120ft. Jib. £2600.
RUSHWORTH 7-ton Hand Derrick, 30ft. Lattice Jib. £245.
COLES 10-ton Diesel/Electric LOCO, 40ft. Jib, 4ft. 8½in. gauge, requires overhaul. £1000.
COLES 10-ton Diesel Electric MOBILE, 40ft. Jib. £4750.
ANDERSON 10-ton Electric DERRICK, 120ft. Jib new 1945. Good condition. £3850.
COLES 12½-ton FULLY MOBILE, 80ft. Jib. £4250.
FOR A COMPREHENSIVE LIST OF PLANT FOR SALE AND HIRE—SEND FOR VALES FREE PLANT REGISTER.
Further details: 14, Lower Grosvenor Place, London, S.W.1. Telephone: VICtoria 7531, 3501, 8080, 9886 (15 lines). E107 G

NISSEN TYPE HUTS for sale. Prompt despatch of 16ft., 24ft., and 30ft. wide huts; also "Romney" Huts, 35ft. wide, and "Blister" Hangars, 86ft. 6in. and 91ft. wide. These buildings are in various lengths and comprise steel framework with galvanised corrugated steel sheeting.—Full details from Dept. 115, J. Thorn and Sons, Ltd., Brampton Road, Bexleyheath, Kent (Tel.: Bexleyheath 305). E113 o

FOR SALE

FRED WATKINS (ENGINEERING) LTD.

STEAM BOILERS.—Cochrane Vertical (New), 8ft. 6in., 8ft., 7ft. 6in., 7ft. and 6ft. in dia. 100/150 lb. w.p.; reconditioned 8ft. 6in. down to 3ft. dia.; Economic 4ft. to 11ft. 6in. dia., including new 7ft. and 8ft. dia., 150, 180 and 200 lb. w.p., 300 reconditioned Vertical Crosstube, all sizes.

AIR COMPRESSORS.—Two Bellis & Morcom 2500 c.f.m., 100 p.s.i., 550 h.p. motors; also Broomwade 500, 400, 300, 200 and 130 c.f.m., all motorised; and several others of various makes and capacities.

200 AIR RECEIVERS, stocked up to 9ft. dia., 100 to 500 lb. pressure.

ELECTRIC MOTORS.—150 Totally Enclosed and Flameproof Motors up to 200 h.p.

MOBILE ROAD CRANES.—10-ton Lorain lorry mounted 30ft.–70ft. extendible jib; 10-ton 33 R.B. track mounted, 40ft. jib; 8½-ton Ransomes Diesel/Electric, 21ft. jib; 6-ton Coles Diesel/Electric, pneumatics, new 1948 (2); 6-ton Coles Diesel/Electric, solids; 4-ton Coles Diesel/Electric, solids; 1945; 4-ton Jones KL44, diesel, 1950; 3-ton Jones "Super 40" diesel, pneumatics (3).

OVERHEAD CRANES.—30/5-ton Adamson 42ft. 3in. span, 400/3/50; 20/6-ton Vaughan, 42ft. 3in. span, cab type (6); 20-ton King, 42ft. 3in. span, 400/3/50; 15-ton Morris, 35ft. span, hand-operated; 10-ton Morris, 45ft. span, 36ft. lift; 10-ton Morris "Goliath," 40ft. span, 400/3/50; 10-ton Vaughan, 23ft. 6in. span, 400/3/50; 10-ton Vaughan, 21ft. span, 44ft. lift, 7½ tons; Wharton, 25ft. span, 400/3/50; 5-ton Henderson, 24ft. 7in. span, 1946; 5-ton Morris, 58ft. span, hand-operated; 5-ton Royce, 2-motor crab, 440/3/50; 5-ton King, 29ft. 3in. span, power hoist, hand travel; 5-ton Morris, 28ft. 6in. span, power hoist, hand travel; 4-ton Morris, 19ft. span, 220V, d.c. (3); 3-ton Adamson, 48ft. span, 400/3/50; 2-ton Adamson, 34ft. span, 400/3/50 (2); 2-ton Morris, 18ft. span; 2-ton Vaughan, 27ft. 6in. span, 2-motor; majority of the above are unused.

DERRICK CRANES.—7-ton Rushworth, hand, 30ft. jib; 5-ton Wilson, electric, 70ft. jib; 1½-ton Anderson Grice, hand, 40ft. jib.

RAIL CRANES.—18-ton Brownhoist, steam, 50ft. jib; 10-ton Coles, steam, 40ft. jib; 10-ton Grafton, 34ft. jib, diesel conversion; 8-ton Wilson, steam, 35ft. jib; 5-ton Grafton, 35ft. jib, diesel conversion; 5-ton Smith, 50ft. jib (2); 5-ton Cowans Sheldon, 50ft. jib.

LOCOS.—Fowler diesel, 150 h.p. (2); Bagnall 14in. by 22in., two oil-fired, one coal; Peckett, steam, 7in. by 12in., 1941; also 3 miles track, 24in. gauge, Bogies, Turnouts, &c.

STEEL PIPING.—50,000ft., 2in. Galvanised, new; 60,000ft. 3in. black, new; 5000ft., 8in. seamless; 1000ft., 12in. seamless; 500ft., 14in. seamless; 400ft., 18in. riveted; 280ft., 21in. o.d. welded flanged; 3800ft., 21in. seamless flanged; 500ft., 24in. riveted; 1450ft., 27in. o.d. welded flanged; 216ft., 48in. riveted; 216ft., 60in. riveted.

CAST IRON PIPES.—Large stocks all sizes up to 24in. flanged and s.s. Immediate delivery.

VALVES.—Exceptional Surplus Ministry Lot, New Stainless Acid Cocks and Valves, over 5000, immediate delivery, below makers' prices. Large stock all sizes, Parallel Slide Sluices, Gunmetal, Reducing and Check Valves. List on request.

STORAGE TANKS.—300 cylindrical and rectangular up to 12,000 gallons, for oil and petrol, also sectional steel and cast iron up to 50,000 gallons.

MACHINE TOOLS.—Scriven Plate Bending Rolls, 14ft. by ¾in.; Robertson Straightening Rolls, 8ft. 6in. by ¾in.; Berry Bending Rolls, 7ft. by ¾in.; Tangye 200-ton Hydraulic Vertical Straightening Press, 15ft. by 3ft. table; Herbert 3ND Miller, 61in. by 15in. table; Pels Punch and Shears, ¾in. capacity; nine new 2 cwt. and 1 cwt. Pneumatic Hammers; Bonn Hydraulic Tube Bender up to 20ft by 4in. bore; two 40kVA Spot Welding Machines; Wire Drawing Machine, 3 die up to ¼in. copper; Berry Guillotine, capacity 4ft. by 1in.; Fielding Hydraulic Tube Bending Machine, 24in. stroke, up to 8in. capacity.

SLING ENGINEERING WORKS
COLEFORD, GLOS.
'Phone: Coleford 2271/2. E106 o

600

ECONOMIC BOILERS

TWO—COCHRAN "SINUFLO" double pass, 10ft. 9in. diam. × 15ft. 8in. over tubeplates; evap. 16,800/18,000 lb./hr.; 120 p.s.i., with chimney, induced draught fans, Thermofeed controls.
ONE—JOHN THOMPSON self-contained, 11ft. diam. × 16ft. over tubeplates; 120 p.s.i., evap. 14,500/15,150 lb./hr., with fittings and I.D. fan
ONE—DANIEL ADAMSON double pass, 10ft. 6in. diam. × 16ft. over tubeplates; evap. 14,400 lb./hr., 1160 p.s.i., with feed pump, chimney, grit arrestor induced draught fan.
TWO—JOHN THOMPSON self-contained treble pass super economic, 9ft. 6in. diam. × 14ft. over tubeplates; 120 p.s.i.; 9500 lb./hr., with fittings, I.D. fan.
All Suited for Coal or Oil Firing.

GEORGE COHEN
Sons & Co. Ltd.
Wood Lane, London, W.12.
(Shepherds Bush 2070)
Stanningley, Nr. Leeds (Pudsey 2241).
E202 o

AERIAL CABLEWAY.—Reconditioned as new, Electric Radial Aerial Cableway; load 10 tons; maximum span 1820 feet; fixed headmast 125 feet high; travelling tail carriage 36 feet high; Igranic contactor control gear; main cable and all ropes new; available 3/4 months.—Full particulars from John M. Henderson and Co., Ltd., King's Works, Aberdeen. E2543 o

Classified Advts. continued on page 152

FOR SALE

600

STEAM ALTERNATOR SETS

Two 1000kW, 3·3kV, 3-phase, 50 cycles, back pressure type Steam Turbo Alternator Sets, each incorporating turbine by BELLISS AND MORCOM. Speed 4500 r.p.m.; steam pressure 195 p.s.i.g., 380 deg. Fah. temp., exhausting against 15 lb back pressure. Direct coupled through David Brown gearbox to alternator by HARLAND ENGINEERING COMPANY, with direct coupled exciter. Switchgear with automatic voltage regulator. Also with hand-operated overhead crane.

750kW, 400V, 3-phase, 50 cycles, back pressure type Steam Turbo Alternator Set by METROPOLITAN-VICKERS; steam pressure 485 p.s.i.g., 550 deg. Fah., back pressures between 25 and 60 p.s.i.g. Complete with BABCOCK AND WILCOX Water Tube type CT. Boiler, evaporation 20,000 lb/hour maximum, heating surface 3805 square feet, 500/525 lb w.p. All the foregoing forms a complete installation, the boiler grate being suitable for fuel of low calorific value, such as sugar cane, &c.

500kW, 625kVA, 400V, 3-phase, 50 cycles, 4-wire back pressure type Steam Turbo Alternator Set by B.T.H. Speed 3000 r.p.m. Steam pressure 300 p.s.i.g., 150 deg. Fah. superheat, 60 lb back pressure. Complete with all fittings, standard ancillaries and switchgear.

Two 350kW, 400/440V, 3-phase, 50 cycles, Steam Engine Driven Alternator Sets incorporating compound engine by BELLISS AND MORCOM, having h.p. cylinder 18in. bore, l.p. cylinder 26in. bore by 11½in. stroke. Developing 500 h.p. when running at 375 r.p.m. and when supplied with steam at 150 p.s.i. exhausting to back pressures up to 20 lb. Direct coupled to alternator by ENGLISH ELECTRIC, having overhung exciter. Complete with switchgear.

300kW, 440V, 3-phase, 50 cycles, 4-wire back pressure type Steam Engine Driven Alternator Set, with compound engine by BELLISS AND MORCOM. For 140/150 p.s.i.g. up to 25 lb back pressure. Speed 375 r.p.m. Coupled to alternator by ENGLISH ELECTRIC COMPANY with switchgear.

GEORGE COHEN,

SONS AND CO. LTD.
WOOD LANE, LONDON, W.12
(Phone: SHEpherds Bush 2070.)
STANNINGLEY, Nr. LEEDS
(Phone: Pudsey 2241.) E201 G

RHODES NO. 22 BAR SHEARING MACHINE for sale. Similar to a double-sided press. Capacity 250 tons. Shears mild steel plates 17in. wide by 1¼in. thick. Arranged motor drive 400/3/50. Width between guides 25¼in. Stroke 5¼in. Weight about 13¾ tons. Photo.—F. J. Edwards, Ltd., 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham, 3. E7501 G

FOR SALE

Edwards

BESCO No. 21 size Inclinable Power Press, Treadle-operated non-repeat clutch, ram fitted with knock-out, fitted with detachable tie bars, standard stroke 3in., centre to back 9½in., bed 27in. by 18in., hole in bed 11¼in. by 12in., can be supplied for belt drive or self-contained motor drive.

ROBERTSON Motorised Geared Section Rolling Machine, at present fitted with rollers for forming 2¼in. by 2¼in. angle sections, diameter of roll shafts 2¼in., width between bearings 16¼in., working centres adjustable up to 7¼in., 14 rollers arranged in 7 pairs, arranged motor drive for 400/440/3/50.

NEW STOELTING Pyramid Type Plate Bending Roller, motorised 400/440/3/50, capacity 10ft. wide by ¼in. mild steel, diameter of rollers, top, 9¼in., bottom 7¾in., drop end bearing for removal of completed cylinders, support rollers to bottom rolls, reduction gearbox drive to bottom rolls with multi-disc slipping clutches, motorised adjustment to top roller.

RUSHWORTH Double-Geared Open-Ended Power Guillotine, Overcrank type, fitted with automatic sheet hold-down and adjustable front, back and side gauges, arranged motor drive for 380/440/3/50, capacity mild steel 4ft. by ¼in., gap in open ends 6¼in.

NEW BESCO 8ft. 4in. by ¼in. Type HK, All Steel Undercrank Open-Ended Production Power Guillotine of all steel construction, arranged motor drive for 400/440/3/50, length of blades 110¼in., capacity ¼in., gap in side frames 3¼in., strokes per minute 54.

CRAIG AND DONALD Model 400/10, All Steel Motorised Double-Geared Press Brake of steel plate construction, arranged motor drive for 440/3/50, pressure exerted 400 tons, former capacity 10ft. by ¼in., depth of gap 12in., width between side frames 82in., stroke approximately 4in., weight approximately 29 tons.

Photographs of the above are available.

MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

Very favourable Hire Purchase terms can be obtained.

F. J. EDWARDS LTD.,

359–361, EUSTON ROAD,
LONDON, N.W.1.
Telephone: EUSton 4681–3771.
And at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone: Central 7606–8.

E207 G

FOR SALE

RICHARDS 7ft. SWING DOUBLE COLUMN VERTICAL BORER

Admits about 3ft. height of work. All geared. M.D. 440/3/50.

H. BELL (MACHINE TOOLS), LTD.,
WALTER STREET, LEEDS, 4.
Tel.: 637398.

E105 G

FOR SALE

RICHARDS No. 3 TYPE PR HORIZONTAL BORING, FACING, MILLING DRILLING AND TAPPING MACHINE with screw cutting attachment; 3¼in. diameter traversing spindle; facing head capacity 42in.; machine fitted with Verniers to longitudinal cross and vertical feeds. Built 1945. In first class condition.

F. J. EDWARDS, LTD.,
359–361, EUSTON ROAD,
LONDON, N.W.1.
EUSton 4681 and 3771.

E7464 G

BOGGED DOWN?

Remember

WARDS might have it!

THOS. W. WARD LTD

ALBION WORKS, SHEFFIELD

HAMMERED OR HYDRAULIC PRESSED

FORGINGS

IN STEEL BLACK OR MACHINED TO 24 TONS

THE INCE FORGE CO. LTD.
WIGAN PARKS FORGE LTD. PROPRIETORS

Enter No. 1521 on reply card

TWIN DISC

Clutches and Power Take-Offs
Single and three-stage Hydraulic Torque Converters.
Marine Reverse and Reduction Gears, Fluid Couplings.

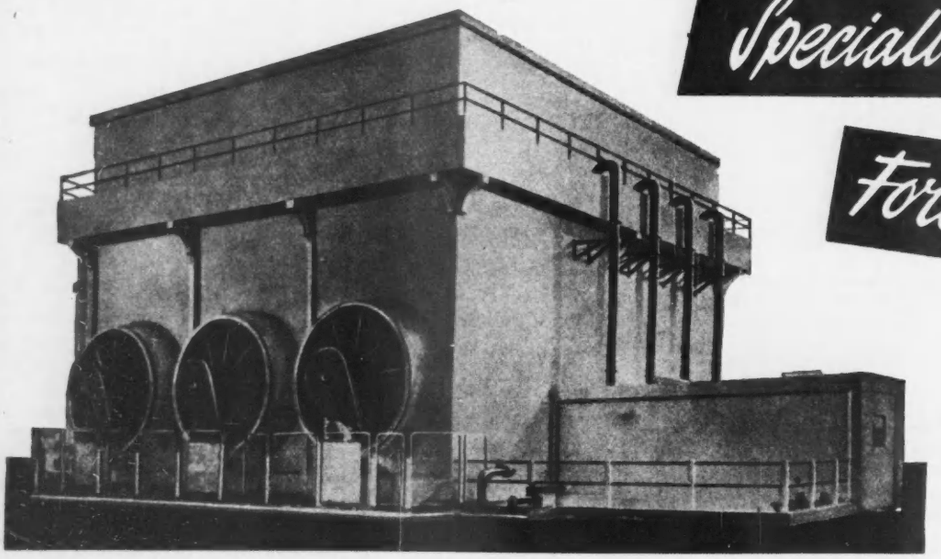
BRITISH TWIN DISC LTD
PRIORY ROAD, STROOD, ROCHESTER, KENT
Telephone: STROOD 78661

Enter No. 1522 on reply card

CASCADE WATER COOLERS

Specialized Cooling...

Forced Draught



We are fully equipped to carry out promptly the erection of Cooling Towers. Our representative will call upon you at any time.

INQUIRIES INVITED.

CASCADE WATER COOLERS LTD., BREWERY LANE, DEWSBURY

Telephone: Dewsbury 173

Enter No. 1523 on reply card

AUCTIONEERS & VALUERS

Established 1850

WHEATLEY KIRK PRICE & CO.

E. L. JUDSON, F.R.I.C.S., F.A.I.
E. J. BEDDARD, A.I.MECH.E., F.A.L.P.A.
M. S. CHEAVIN, F.A.I.
G. E. GIBBS, F.A.L.P.A.

SURVEYORS, VALUERS and AUCTIONEERS of FACTORIES, PLANT and MACHINERY

FIRE LOSS ASSESSORS

9, REX PLACE, LONDON, W.1.
Telephone : HYDE PARK 8844/5/6 (3 lines)

KNIGHT, FRANK & RUTLEY

SALE & VALUATION OF FACTORIES PLANT AND MACHINERY

20, Hanover Square, W.1.

Telephone : MAYfair 3771

(Factory Department : Ext. 17)

JOHN FOORD & COMPANY

VALUERS AND ASSESSORS OF WORKS, FACTORIES ENGINEERING PLANT AND MACHINERY

56, VICTORIA STREET, LONDON, S.W.1.

VICTORIA 2002/3/4

Established Over a Century

FOR SALE

TWW

VICTORIA U.2 UNIVERSAL MILLING MACHINE with vertical and slotting attachment. HYDETSCO MODEL 6.H PLANO SHAPING MACHINE, stroke 36in., table 24in. × 36in. PLANERS HUDDERSFIELD 12ft. × 4ft. Planing Machine.

THOS. W. WARD LTD.

BRETTENHAM HOUSE, STRAND, LONDON, W.C.2.
'Phone : TEMple Bar 1515 (12 lines)
Remember . Wards might have it !

E215 G

AUCTIONEERS & VALUERS

HENRY BUTCHER AND CO.

Auctioneers, Valuers and Surveyors

Specialising in the

SALE & VALUATION of ENGINEERING & ALLIED WORKS PLANT & MACHINERY

73, Chancery Lane, London, W.C.2.
HOLBORN 8411 (8 lines)

By Order of the Liquidator
Re : Pease and Partners, Ltd. (Member's Voluntary Winding-Up)

FOR SALE AS A GOING CONCERN

TEES IRONWORKS, MIDDLESBROUGH, YORKS

EXTENSIVE WATERSIDE FREEHOLD FOUNDRY AND LAND GROUND AREA APPROXIMATELY 13·75 ACRES
Frontage to the River Tees.
Comprehensive railway siding facilities. Substantial single-storey building.
FLOOR SPACE OVER 100,000 SQUARE FEET
Including foundries with cranes up to 15 tons capacity. Ancillary Buildings, Office Block, Machine Shop, &c.

Seven Cupolas : melting capacities ranging from 2 tons to 10 tons per hour. There are three foundries, one a heavy jobbing foundry suitable for castings up to 14 tons weight each, another a mass production foundry for castings up to 2 cwts. each and a new foundry for the production of castings in Spheroidal-Graphite cast iron.

THE PRODUCTS include :
Castings for steel works, marine and general engineering in Spheroidal-Graphite ; Hematite and Grey Iron and all types of railway castings including : chairs and brake blocks.

THE PLANT AND MACHINERY
in the main includes : Moulding Machines ; Drying Units ; Elevators and Conveyors ; Sand Drying and Mixing Machines ; Geared Ladles up to 10 tons ; Foundry and Moulding Boxes ; Weighing Machines ; Electrical and Sub-Station Equipment ; Woodworking Machines ; S.S. and S.C. Lathes ; Boring, Drilling, Grinding and Planing Machines ; Steam Cranes and Locos ; Air Compressors ; Electric Motors ; Laboratory and Test Equipment.
Note : The waterside frontage is at present let on a short-term Tenancy producing £750 per annum.
Full Particulars of :

Henry Butcher & Co.
Auctioneers, Valuers and Surveyors of Factories, Plant and Machinery, 73, Chancery Lane, London, W.C.2. Tel.: HOLborn 8411 (8 lines).

E7458 J

RICHARDS AND PARTNERS

Auctioneers, Surveyors and Valuers

Specialists in the

VALUATION & SALE of INDUSTRIAL PROPERTY PLANT and MACHINERY

3, Arundel Street, London, W.C.2.
TEMple Bar 7471

FOR SALE

"SENTINEL" 48in. Non-Rising Geared Stem Gate Valve, working pressure 15 p.s.i. Price £190.—R. S. Hayes, Ltd., Bridgend, Glam. Tel.: Bridgend 1311 (3 lines).

E7439 G

AUCTIONEERS & VALUERS

ESTABLISHED 1877

LEOPOLD FARMER & SONS

conduct

AUCTION SALES and VALUATIONS OF PLANT, MACHINERY AND INDUSTRIAL PROPERTIES

FACTORY INVESTMENTS MORTGAGES ARRANGED

46, GRESHAM STREET, LONDON, E.C.2.

Telephone : Monarch 3422 (8 lines) Telegrams : Sites, London

AUCTIONEERS & VALUERS

Established 1807

FULLER, HORSEY SONS & CASSELL

Specialists IN THE SALE & VALUATION OF WORKS and MANUFACTORIES ENGINEERING PLANT and MACHINERY

10, LLOYD'S AVENUE LONDON, E.C.3.

Telephone : ROYAL 4861

E R

By Order of the Minister of Supply

GOVERNMENT SURPLUS STORES

SALES BY AUCTION

		Main Location	*Auctioneers*
October 9	Vehicles and miscellaneous stores.	Central Ordnance Depot, Bicester, Oxon.	MIDLAND MARTS, LTD. (Dept. L), Market Square, Bicester, Oxon. (Tel.: 73.)
October 14	Miscellaneous stores, including :—	Northern Command Ordnance Sub Depot, Barlow, Nr. Selby, Yorks.	BARTLE & SONS (Dept. L), 50–52, Merrion Street, Leeds, 2. (Tel.: 2.0898.)
	lathes ; drilling machines ; millers ; shaping machines ; generators ; battery chargers ; gravity roller conveyors ; weighing machines ; large tonnage of hutting components ; batteries ; electric cable ; tyres ; hand tools ; tool kits ; large quantity of aluminium mess tins ; greatcoats ; webbing ; kit bags ; pullovers ; haversacks ; tentage ; canvas sheets ; tarpaulins ; anti-gas clothing ; office and other furniture ; kitchen ware ; cutlery ; paint ; rags ; etc.		
October 20-23	Vehicles, earth-moving and lifting equipment, motor cycles, etc.	M.O.S. Storage Depot, Ruddington, Notts.	WALKER, WALTON & HANSON (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 54272.)
October 23	Clothing and miscellaneous stores.	Command Ordnance Depot, Coypool, Marsh Mills, Plymouth. (Sale at Kinterbury House.)	WOOLLAND, SON & MANICO (Dept. L), Kinterbury House, St. Andrews Cross, Plymouth. (Tel.: 65356.)
October 27-29	Machine tools and miscellaneous stores.	M.O.S. Storage Depot, Royal Arsenal, Woolwich, S.E.18.	FULLER, HORSEY, SONS & CASSELL (Dept. L), 10, Lloyd's Avenue, E.C.3. (Tel.: Royal 4861.)
November 3	Miscellaneous stores.	Command Ordnance Sub-Depot, Devizes. (Sale at Corn Exchange, Devizes.)	FARRANT, WIGHTMAN & PINNIGER (Dept. L), 2, Newport Street, Swindon, Wilts. (Tel.: 5151/2.)

Applications for catalogues, available 14 days prior to date of sale, should be made *only* to the auctioneers shown above (price of catalogue 1s. 0d., P.O. only).

SALE BY TENDER

A DROOP & REIN plane milling machine with 5 heads : Table 178in. by 47in.: 55in. under the vertical spindles, also NASSOVIA die sinkers. Located at Elstow and Sevenhampton.

Tenders must be submitted by 19th October, 1959.

Applications for tender forms should be made to the Ministry of Supply, Directorate of Disposals, First Avenue House, High Holborn, London, W.C.1.

E118 J

FOR SALE

HYDRAULIC FORMING AND FORGING PRESSES

3000-ton Down-stroke PRESS for HEAVY PLATE FORMING AND BENDING, rams ; admitting 10ft. 6in. between columns ; bed 16ft. by 8ft.

2000-ton Down-stroke FORGING PRESS, 5ft. stroke ; bed 8ft. 6in. by 8ft. ; daylight 11ft.

1000-ton Down-stroke FORGING PRESS by Wellman, bed 7ft. by 6ft. ; daylight 9ft.

475-ton FLANGING PRESS by Hugh Smith, table 10ft. dia., 4 vice rams.

REED BROTHERS (ENGINEERING), LTD., Replant Works, Woolwich Industrial Estate, London, S.E.18. Telephone : Woolwich 7611/6.

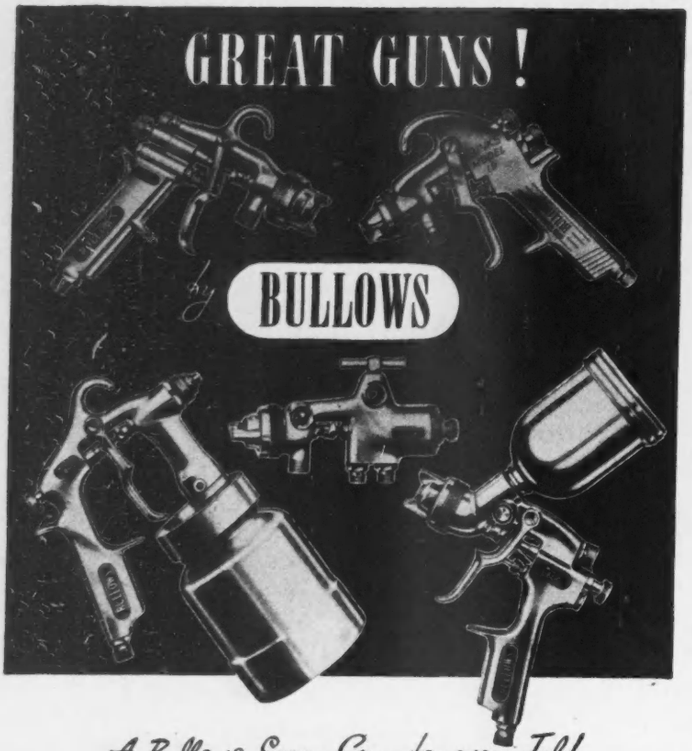
E7479 G

FOR SALE

FRED WATKINS (ENGINEERING) LTD.

Fielding 500-ton Vertical Downstroke Hydraulic Press, 42in. by 36in. platens, with pumps and motors.
Fielding 200-ton, ditto, 3ft. stroke, with pumps and motors (5 available).
Fielding 100-ton ditto, 4ft. to 5ft. stroke, with pumps and motors.
Two 73ft. 4in. by 5ft. Kilns or Dryers, with Crofts Reduction Gear and 27 h.p. motor.
Two 26ft. by 4ft. Rotary Cooler or Dryers, with reduction gear and motor.
Available at low prices ex present sites to save cost of bringing into stock.

FRED WATKINS (ENGINEERING), LTD., COLEFORD, GLOS. E151 G



A Bullows Spray Gun for every Job!

AIR COMPRESSORS • SPRAY PAINTING EQUIPMENT • SPRAY BOOTHS

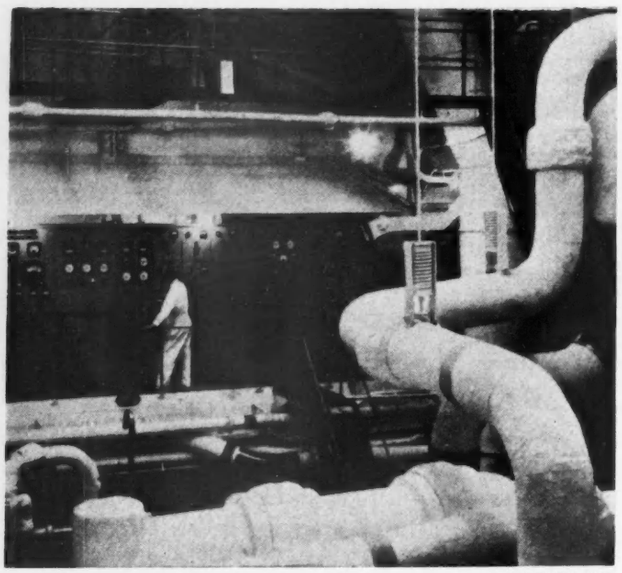
ALFRED BULLOWS & SONS LTD

HEAD OFFICE & WORKS · LONG ST · WALSALL · STAFFS · ENGLAND · TEL. 5401

Makers of the original oil-sealed rotary compressors

13 SOUTH MOLTON ST., LONDON, W.1. TEL: MAYFAIR 2313 · 61/63 DRURY ST., DUBLIN. TEL: DUBLIN 73188/9
55a BRIDGE ST., MANCHESTER, 3. TEL: BLACKFRIARS 5670 · 70 GILMOUR ST., GLASGOW, C.5. TEL: SOUTH 2383

Enter No. 1541 on reply card



A BP PHOTOGRAPH

IT JUST SO HAPPENS...

. . . that this photograph shows the engine room of an oil tanker. We could with equal point show a sub-station switchroom, solvent store or a nuclear reactor building, because wherever you find valuable plant you will find Kidde CO_2 Fire Protection—either in single extinguisher units or as a built-in system—reliable, swift and completely harmless to the machinery it protects.

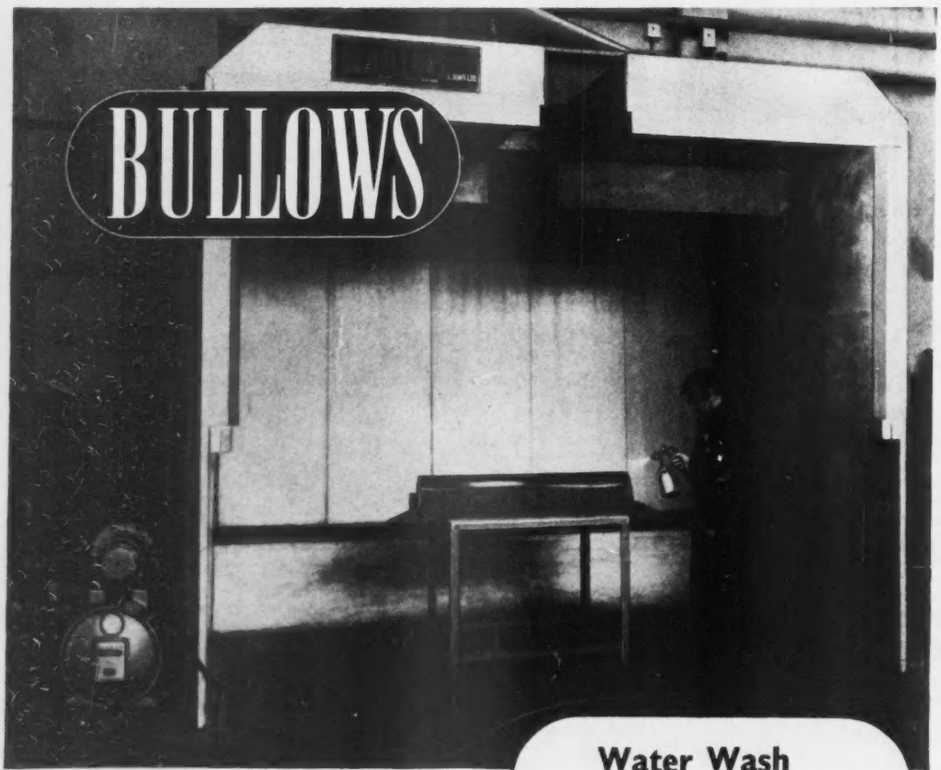
THE WALTER KIDDE COMPANY LTD

Industrial Built-in Fire Protection

Fire Detection Systems · Portable CO_2 Extinguishers

Northolt · Middlesex (K Kidde) *Telephone: Vikirg 6611*

Enter No. 1542 on reply card



Water Wash Spray Booth

AT

JOHN JARDINE LTD.

DEERING STREET · NOTTINGHAM

typical of the many BULLOWS Spray Booths installed in well-known Industrial Plants throughout the country. Consulting us incurs no obligation.

DEPOTS AT

13 SOUTH MOLTON ST · LONDON, W.1 · TEL. MAYFAIR 2313
55A BRIDGE STREET · MANCHESTER 3 · TEL. BLACKFRIARS 5670
61/63 DRURY STREET · DUBLIN · TEL. DUBLIN 73188/9
70 GILMOUR STREET · GLASGOW C.5 · TEL. SOUTH 2383

A. BULLOWS & SONS LTD LONG ST · WALSALL · STAFFS · Tel. 5401 *Makers of the original oil-sealed rotary compressors*

Enter No. 1543 on reply card

INDEX TO ADVERTISERS

PAGE

A.C.E. Machinery, Ltd. 102
A.E.C., Ltd. Cover v
Abbot Engineering Co., Ltd. 97
Aero Maintenance Equipment, Ltd. 76
Allen, W. G., & Sons (Tipton), Ltd. 21
Alley & MacLellan (Polmadie), Ltd. 59
Ames Crosta Mills & Co., Ltd. 24
Anderson-Grice Co., Ltd. 96
Andre Rubber Co., Ltd. 32
Archdale, J., & Co., Ltd. 105
Arrol, Sir William, & Co., Ltd. Cover ii
Associated Electrical Industries, Ltd. 56-61-68
Autohall 92
Autometric Pumps, Ltd. 104
Automotive Products Co., Ltd. 106
Avery, W., & T., Ltd. 2

B.R.C. Engineering Co. 30
Babcock & Wilcox, Ltd. 9
Baker, W. A., & Co., Ltd. 126
Barnet Metal Co., Ltd. 128
Barr Thomson & Co., Ltd. 24
Begg, Cousland & Co., Ltd. 133
Belmos Co., Ltd. 17
Bering Engineering, Ltd. 95
Birfield Industries, Ltd. 36-62
Birmetals, Ltd. 146
Birmingham & Blackburn Construction Co., Ltd. 24
Blackwood Hodge 109
Blakeborough, J., & Sons, Ltd. 60
Boby, W., & Co., Ltd. 117
Boilerine, Ltd. 139
Booth, J., & Bros. 73
Booth, J., & Co., Ltd. 135
Borg & Beck Co., Ltd. 89
Braby, F., & Co., Ltd. 143
Brightside Plating Co., Ltd. 55
British & General Tube Co., Ltd. 133
British Ermeto Corporation, Ltd. 7
British Federal Welder & Machine Co., Ltd. 55
British Industrial Engineering Co. (Staffs), Ltd. 132
British Jeffrey-Diamond, Ltd. 23
British Paints, Ltd. 63
British Rolling Mills, Ltd. 50
British Twin Disc, Ltd. 152
Bronx Engineering Co., Ltd. 122
Broom & Wade, Ltd. 29

PAGE

Brotherhood, P., Ltd. 126
Brownlie & Murray, Ltd. 128
Bull, J., Rubber Co., Ltd. 20
Bullers, Ltd. 88
Bullows, A., & Sons, Ltd. 154
Burgess Products Co., Ltd. 22
Burnett & Rolfe, Ltd. 122
Butcher, H., & Co. 153
Butterfield, W. P., Ltd. 93

C. & M. Engineering Co., Ltd. 58
Cascade Water Coolers, Ltd. 152
Christy & Norris, Ltd. 134
Ciba (A.R.L.), Ltd. 108
Clarke Chapman & Co., Ltd. 25
Clarkson (Engineers), Ltd. 27
Clayton Crane & Hoist Co., Ltd. 119
Clyde Crane & Booth, Ltd. 73
Clyde Crane & Engineering Co. 73
Clyde Rubber Works Co., Ltd. 138
Clydeside Machine Tool Co., Ltd. 140
Cohen, G., Sons & Co., Ltd. 18-19-156
Conveyor & Elevator Co. (1936), Ltd. 8
Crofts (Engineers), Ltd. 110-111
Cross Manufacturing Co. (1938), Ltd. 98
Crowthorn Engineering Co., Ltd. 104

Darwins, Ltd. 101
Datim Machine Tool Co., Ltd. 112
Delta Metal Co., Ltd. 139
Demag A.G. 35
Douglas, Lawson & Co., Ltd. 104

Eagle & Wrights (Gauges), Ltd. 114
Electrical Power Engineering Co. (B'ham), Ltd. 128
Ellison, G., Ltd. 79
English Abrasives Corporation, Ltd. 113
English Electric Co., Ltd. 34
English Numbering Machines, Ltd. 98
Etchells, D. (Furnaces), Ltd. Cover v
Evans, F. W., Ltd. 126
Evode, Ltd. 53
Expanded Metal Co., Ltd. 114

PAGE

Fairey Engineering, Ltd. 10
Farmer, L., & Sons. 153
Farrar Boilerworks, Ltd. 84
Ferodo, Ltd. 141
Firth Brown Tools, Ltd. 91
Firth, T., & Brown, J., Ltd. 87
Firth-Vickers Stainless Steels, Ltd. 67
Flexello Castors & Wheels, Ltd. 23
Foord, J., & Co. 153
Ford Motor Co., Ltd. 138
Foyles 58
Fuller, Horsey, Sons & Cassell 153

General Descaling Co., Ltd. 83
General Electric Co., Ltd. 120-130-131
Gloucester Foundry, Ltd. 6
Govan Shafting & Engineering Co. 77
Grafton Cranes, Ltd. 88
Greening, N., & Sons, Ltd. 125
Greenwood's Standard Gear Cutting Co., Ltd. 119
Guest, Keen Iron & Steel Co., Ltd. 64

H.M.S.O. 149
Hall Bros. (West Bromwich), Ltd. 84
Hall, J. & E., Ltd. 82
Harland & Wolff, Ltd. 12
Harland Engineering Co., Ltd. 99
Harper, J., & Co., Ltd. 155
Hartley Reece & Co., Ltd. 103
Harvey & Longstaffe, Ltd. 83
Harvey, G. A., & Co. (London), Ltd. 136
Harvey Ironworks, Ltd. 125
Heatrae, Ltd. 6
Hillside Foundry & Engineering Co. (Cupar), Ltd. 27
Hoesch Werke A.G. 69
Holmes, W. C., & Co., Ltd. 45
Holroyd, J., & Co., Ltd. 123
Horseley Group 64
Hot Dip Galvanizers Association 95
Howden, J., & Co., Ltd. 49
Hunt Bros. (Oldbury), Ltd. 125

Imperial Chemical Industries, Ltd., Billingham Division 16

PAGE

Impregnated Diamond Products, Ltd. 106
Ince Forge Co., Ltd. 47-152
International Combustion Products, Ltd. 31
Ironsides Lubricants, Ltd. 83

Kabelschlepp G.m.b.H. 115
Kempe's Engineers Year-Book 149
Kidde, W., Co., Ltd. 154
Klinger, R., Ltd. 70-71
Knight, Frank & Rutley 153
Knitmesh, Ltd. 119
Krupp, Fried 13

Lafarge Aluminous Cement Co., Ltd. 81
Lang Pneumatic, Ltd. 48
Lee & Wilkes, Ltd. 74
Leyland Motors, Ltd. 144
Lincoln Electric Co., Ltd. 38
Lister-Blackstone 142
Londex, Ltd. 95
Loveridge, Ltd. 128

McNeil, C., Ltd. 137
Machinery Installations, Ltd. 145
Main, A. & J., & Co., Ltd. 74
Mancuna Engineering, Ltd. 95
Mann Egerton & Co., Ltd. 115
Marley, W. H., & Co., Ltd. 119
Mason, E. N., & Sons, Ltd. 57
Mathison, J., Ltd. 8
Mavor & Coulson, Ltd. 54
Measurement, Ltd. 41
Mercedes-Benz 33
Metal Structures, Ltd. 140
Metropolitan - Cammell Carriage & Wagon Co., Ltd. 100
Michell Bearings, Ltd. 128
Midgley & Sutcliffe, Ltd. 65
Midland Silicones, Ltd. 14-15
Millers Rings, Ltd. 139
Mills, G. (Engineers), Ltd. 140
Mirrlees (Engineers), Ltd. 86
Mirrlees Watson Co., Ltd. 120
Morgan Refractories, Ltd. 75
Moss Gear Co., Ltd. 93
Mould, A. H., & Sons, Ltd. 116

Niagara Screens (Great Britain), Ltd. 43
Nicol & Andrew, Ltd. 46
Nitralloy, Ltd. 8
Non-Ferrous Die Casting Co., Ltd. 104

PAGE

Norris Bros., Ltd. 98
Norton, Sir J. Farmer & Co., Ltd. 5

Opperman Gears, Ltd. 51
Osborn, S., & Co., Ltd. 40

Parmiter Hope & Sugden, Ltd. 42
Parsons, C. A., & Co., Ltd. 52
Paterson Engineering Co., Ltd. 80
Peckett & Sons, Ltd. 145
Peglers, Ltd. 76
Phillips, J. W., & C. J., Ltd. 114
Pinchin, Johnson & Co. 44
Pittam, J., & Co. 90
Platt Malleable Castings, Ltd. 77
Pratt Bros. (Stourbridge), Ltd. 27
Prestons, Ltd. 23
Price, J. T., & Co., Ltd. 12

Q.V.F., Ltd. 92

Rayner, P., Ltd. 43
Reavell & Co., Ltd. 85
Reed Crane & Hoist Co., Ltd. 122
Reining, Heinrich, G.m.b.H. 44
Research Engineers, Ltd. 83
Reyrolle, A., & Co., Ltd. 124
Richards & Partners. 153
Rivlink Belts, Ltd. 137
Robertson & Ferguson, Ltd. 5
Robinson, L., & Co. (Gillingham), Ltd. 78
Robson, G., & Co. (Conveyors), Ltd. 58
Ross, R. G., & Son, Ltd. 20
Rotherham & Sons, Ltd. 137

SWF 85
St. Georges Engineers, Ltd. 44
Salter, G., & Co., Ltd. Cover vi
Schieldrop & Co., Ltd. 98
Schiess A.G. 39
Selson Machine Tool Co., Ltd. 142
Siemens-Schuckertwerke A.G. 11
Simmonds Aerocessories, Ltd. 107
Sinex Engineering Co., Ltd. 134
Skerne Works, Ltd. 78
Slick Brands, Ltd. 84
Smedley Bros., Ltd. 58
Smith & Grace, Ltd. 74
Smith, S., & Sons (England), Ltd. 129

PAGE

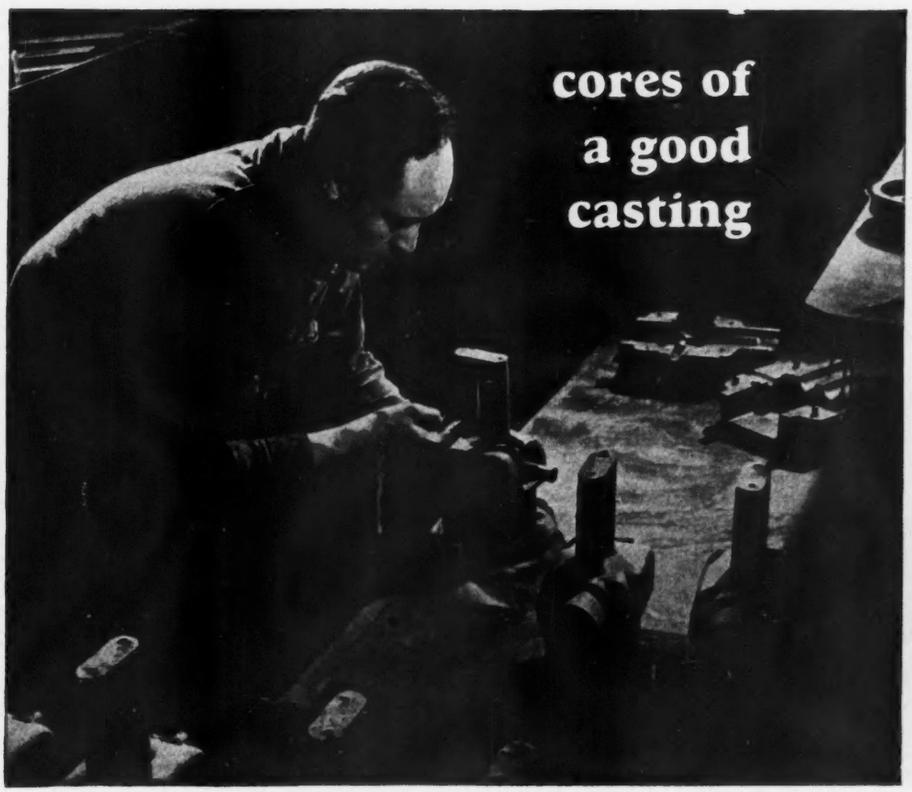
Spenborough Engineering Co., Ltd. 26
Stainless Steel Wire Co., Ltd. 118
Sturtevant Engineering Co., Ltd. 190
Sulzer Bros. (London), Ltd. 94
Summerson, T., & Sons, Ltd. 113
Sunbeam Anti-Corrosives, Ltd. 43
Sutcliffe, R., Ltd. 37

T. & T. Works, Ltd. 63
Tangyes, Ltd. 80-93
Taylor & Hubbard, Ltd. 116
Taylor Stoker Co., Ltd. 96
Taylor Woodrow 127
Telco, Ltd. 8
Thornycroft, J. I., & Co., Ltd. 97
Tilghman's, Ltd. 4
Turner Bros. Asbestos Co., Ltd. 139
Twiflex Couplings, Ltd. 58

Unbrako Socket Screw Co., Ltd. 77
United Flexible Metallic Tubing Co., Ltd. 28

Vaughan Bros. (Drop-Forgings), Ltd. 140
Venus Pencil Co., Ltd. 116
Visco Engineering Co., Ltd. 3

Wailes Dove Bitumastic, Ltd. 121
Wallsend Slipway & Engineering Co., Ltd. 66
Ward, T. W., Ltd. 47-152
Wellman Bibby Co., Ltd. 138
Wellman Smith Owen Engineering Corporation, Ltd. 46
Wellworthy, Ltd. 112
West Yorkshire Foundries, Ltd. 118
Westinghouse Brake & Signal Co., Ltd. 48
Westwood, J., & Co., Ltd. 133
Wheatley & Whiteley 98
Wheatley, Kirk Price & Co. 153
Whitehouse Industries, Ltd. 72
Wiggins, F., & Sons. 77
Wiggin, H., & Co., Ltd. Cover i
Wiley, J., & Sons, Ltd. 88
Wilkinson Rubber Linatex, Ltd. 78
Windley Bros., Ltd. 137
Wiseman, A., & Co., Ltd. 103



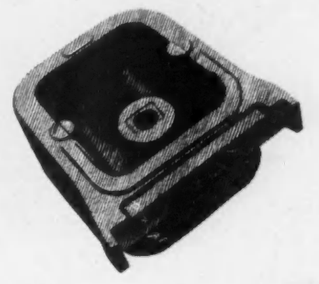
CASTINGS WITH THE HARPER SKIN

THE SKILL of the individual craftsman still plays a very important part in the making of high-grade castings. This skill, together with modern foundry practice, has made Harper castings famous since 1790.

Harper quality covers Grey Iron, Spheroidal Graphite Iron (Mond Nickel Licence) and Meehanite castings. Metal pressings, machining, enamelling and sub-assembly work.

The word MEEHANITE is a registered trade mark

Also makers of the famous Beatrice Oil Heaters and Harper Housewares.



HARPER CASTINGS

JOHN HARPER & CO. LTD. WILLENHALL STAFFS

Phone: WILLENHALL 124 (5 lines) LONDON, Phone: ABBey 5906/7 MANCHESTER, Phone: BLAckfriars 0259

FOUNDED 1790

H 658

Enter No. 1551 on reply card

600

GEORGE COHEN SONS AND COMPANY LIMITED

announce that they have acquired
the Entire Contents of a large Works in

CUMBERLAND

PLANT FOR SALE INCLUDES

LANCASHIRE BOILERS · ECONOMISERS · ELECTRICAL AND STEAM DRIVEN FEED PUMPS · FANS · COAL HANDLING PLANT · ELEVATORS AND CONVEYORS BUNKERS · STEEL CHIMNEYS · 2500 KW TURBO ALTERNATOR GENERATING SET H.T. AND L.T. SWITCHGEAR · PUMPING SETS · HAND OPERATED CRANE INDUSTRIAL LIFT · HAULAGE CAPSTANS · COOLING WATER TOWER · WEIGHING MACHINES · STEELWORK AND TRUSSES OF BUILDINGS · RAILWAY SIDINGS · TANKS PIPING AND VALVES, ETC.

The Plant is in good condition and has been in service for a limited period only.

OFFERED AT ATTRACTIVE PRICES FOR SALE EX SITE

Further details of goods offered can be obtained from: Power Plant Department, 600 Wood Lane, London, W.12. Telephone: SHEpherds Bush 2070. Stanningley, Near Leeds. Telephone: Pudsey 2241.

GEORGE COHEN

SONS AND COMPANY LIMITED

600 WOOD LANE · LONDON · W.12

Telephone: SHEPHERDS BUSH 2070 Telegrams: OMNIPLANT, TELEX, LONDON

And at

STANNINGLEY, NR. LEEDS

Telephone: PUDSEY 2241 Telegrams: OMNIPLANT LEEDS

And at: **KINGSBURY (NR. TAMWORTH); MANCHESTER; GLASGOW; SWANSEA; NEWCASTLE-ON-TYNE; SHEFFIELD; SOUTHAMPTON; BELFAST; BATH**

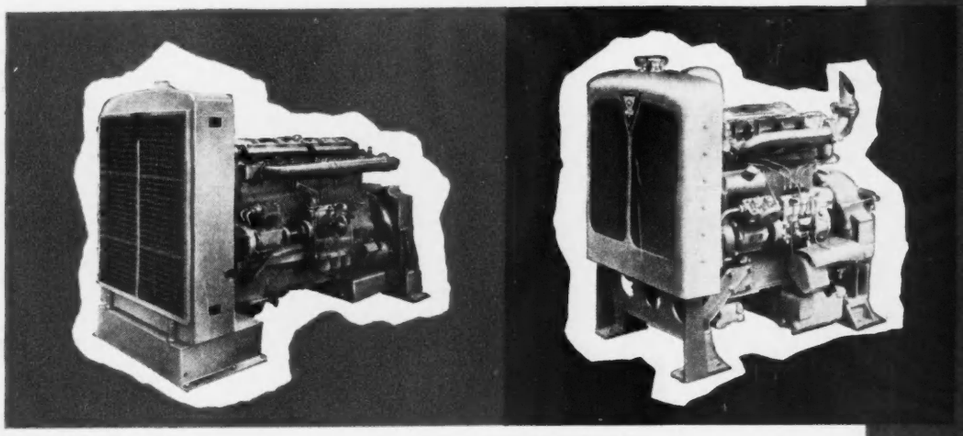
THE 600 GROUP OF COMPANIES

Enter No. 1561 on reply card

PRINTED BY GEORGE REVEIRS, LTD., 10/12, ROSEBERY AVENUE, LONDON, E.C.1, FOR THE PROPRIETORS, MORGAN BROTHERS (PUBLISHERS), LTD., 28, ESSEX STREET, STRAND, LONDON, W.C.2. 8½/1/2½

where you need POWER you need A.E.C. diesels

No other power units will prove so consistently efficient for industrial plant and contracting equipment as the A.E.C. range of high torque diesel engines. From 50 b.h.p. to 275 b.h.p. (turbo-charged up to 360 b.h.p.), they develop an instant, lively, full-throated flexible power year in and year out—at a consistently low cost. Their outstanding efficiency is based on A.E.C.'s 30 years' experience of designing and building diesel units for widely varying duties, their inherent dependability is still further assured by world-wide service facilities.



275 b.h.p. AV1100G 6-cyl. diesel engine **50 b.h.p.** AV312G 4-cyl. di[illegible] engine

A.E.C. DIESELS ARE PROVIDING POWER FOR: [illegible] A.E.C. LIMITED MARINE AND INDUSTRIAL DIVISION A.E.C. WORKS, SOUTHALL, MIDDLESEX

Enter No. C51 on reply card

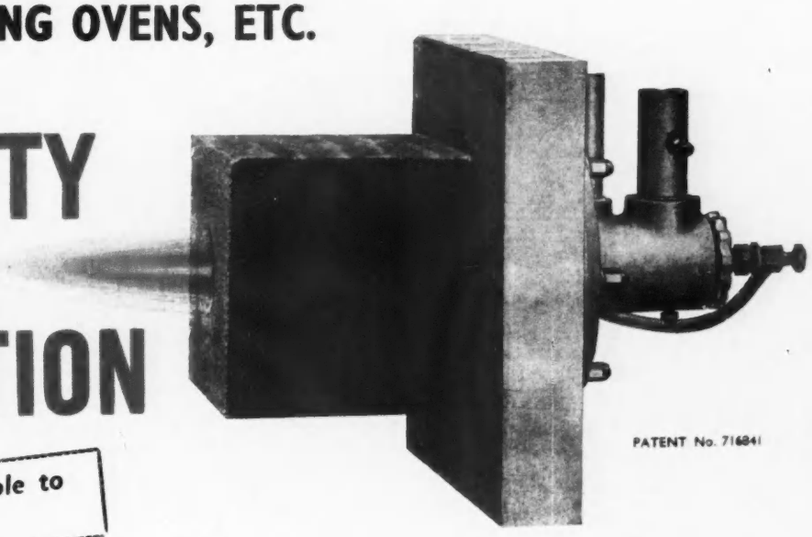
FURNACE ETCHELLS ENGINEERS

Designers and Manufacturers of

FORGE, GALVANIZING AND HEAT TREATMENT FURNACES, DRYING OVENS, ETC.

incorporating our

HIGH INTENSITY SMOKELESS OIL COMBUSTION



PATENT No. 716841

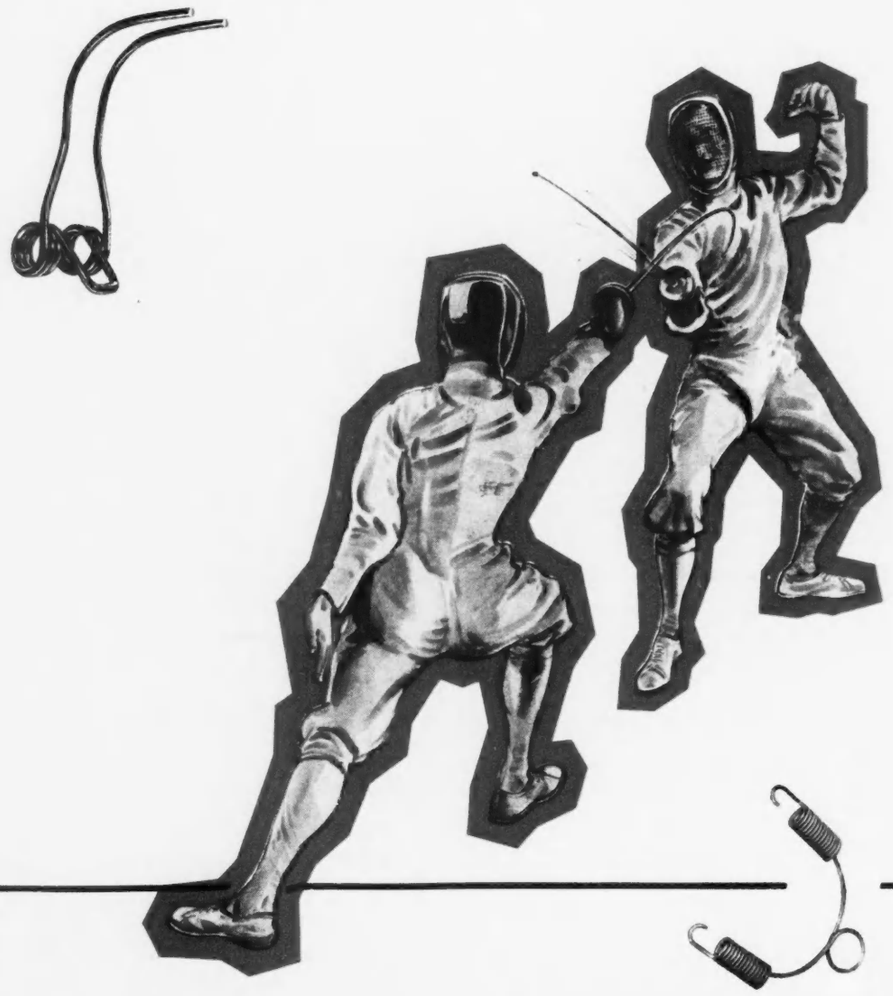
Our Technical Staff are available to advise on all applications

DAVID ETCHELLS (FURNACES) LTD

STAFFORD ROAD, DARLASTON, SOUTH STAFFS Phone: James Bridge 2067/8

Enter No. C52 on reply card

PERFECTION in action



Singleness of purpose and years of experience lie behind any apparently effortless performance.
And so it is with springs.
It's taken for granted that Salter Springs will keep on and on, doing their job with smooth precision—indefinitely.
But it has taken nearly two centuries of skill and devotion to achieve so great a reputation for reliability that—ironically enough—the greatest compliment paid to Salter Springs is that you can forget them!

FOR TOP PERFORMANCE—SPECIFY

SALTER

THE **ALL ACTION** SPRINGS

GEO. SALTER & CO. LTD · WEST BROMWICH · ENGLAND

Established 1760

Enter No. C6 on reply card